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MANUAL OF DISSECTION
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PART. I.

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OF THE
DISSECTION
OF THE
H U M A N B O D Y.

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A
M A N U A L
OF THE
DISSECTION
OF THE
H U M A N B O D Y.

BY
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DEMONSTRATOR OF ANATOMY AT ST. BARTHOLOMEW'S HOSPITAL.

PART I.

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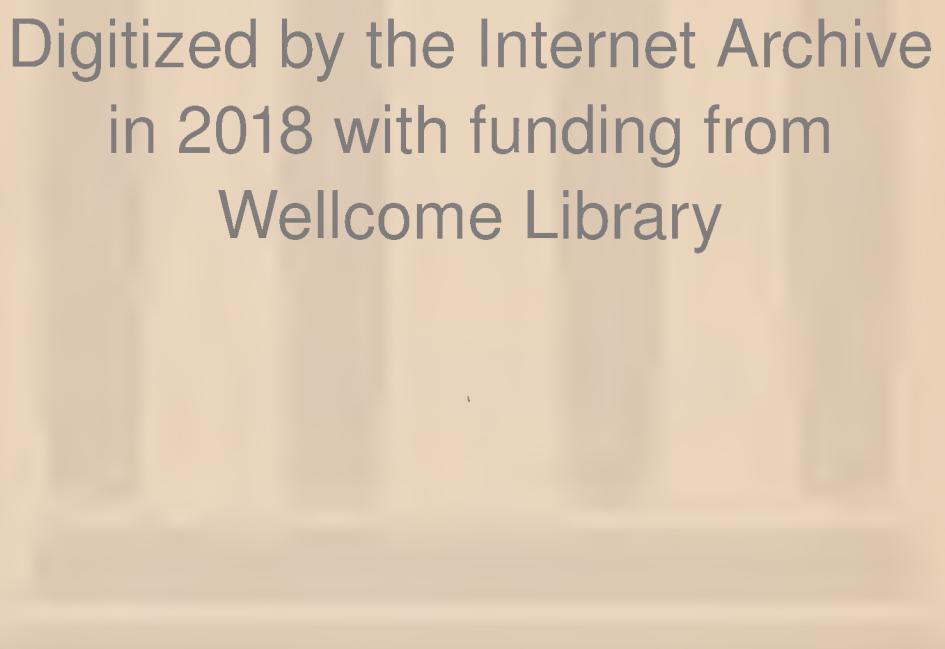
TO THE
S T U D E N T S
OF
ST. BARTHOLOMEW'S HOSPITAL,

IN THE HOPE
THAT IT MAY ASSIST THEM IN THEIR ANATOMICAL STUDIES,

THIS MANUAL IS DEDICATED

BY THEIR FAITHFUL FRIEND AND SERVANT,

THE AUTHOR.



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P R E F A C E.

If any apology be needed for the appearance of the present Manual, it may be stated, without any wish to disparage the labours of others, that the works of this kind hitherto published seem to the Author open to one or the other of two objections:—either as being too systematic, and therefore not adapted for the dissecting-room, or as obscuring the more important features of anatomy by a multiplicity of minute and variable details.

In endeavouring to supply a presumed deficiency, the Author has made it his special aim to direct the attention of the student to the prominent facts of anatomy, and to teach him the groundwork of the science; to trace the connexion, and to point out the relative situation of parts, without perplexing him with minute descriptions.

A concise and accurate account is given of all the parts of the human body, the bones excepted, of which a competent knowledge is presupposed; and directions are laid down for the best method of dissecting it.

The several regions of the body are treated of in the order considered most suitable for their examination ; and the muscles, vessels, nerves, &c. are described, as they are successively exposed to view in the process of dissection.

The arrangement by numbered paragraphs and subdivisions has been adopted to facilitate reference.

It is intended to publish the work in Four Parts, comprising the Dissection of the Arm, that of the Head and Neck, the Abdomen and Pelvis, and the Leg, respectively.

The Author has written the work entirely from actual observation : at the same time no available sources of information have been neglected, the highest authorities both English and Foreign having been carefully consulted. His acknowledgments are especially due to F. C. SKEY, Esq. F.R.S. Lecturer on Anatomy at St. Bartholomew's Hospital, for many valuable suggestions. He is also much indebted to his young friend, Mr. W. CLUBBE, for able assistance in dissections.

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A

MANUAL

OF THE

DISSECTION OF THE HUMAN BODY.

THE DISSECTION OF THE ARM.

1. The arm being placed at a right angle with the body, let three incisions, not dividing more than the thickness of the skin, be made in the following directions. The first, along the front of the sternum from its upper to its lower end ; the second, along the whole length of the clavicle ; the third, commencing at the lower end of the sternum, should be continued outwards for four inches, and thence upwards along the front border of the axilla to the arm.

The skin should be carefully separated from the subjacent layer of adipose and cellular tissue, usually called the *superficial fascia*, a structure which exists, in greater or less development, over nearly the whole of the body. It consists of fibro-cellular tissue, containing within its cells a variable quantity of fat, and is intimately united to the skin by a number of fibrous processes, but more loosely connected to the parts beneath, so that the skin is enabled to move freely over them.

From the superficial fascia over the front of the chest arises a broad cutaneous muscle, called the *Platysma myoides*. It consists of thin, pale, and sometimes scarcely perceptible muscular fibres, which ascend over the clavicle, and are continued along the side of the neck, to the lower jaw and the cheek.

2. Numerous vessels and nerves ramify in the subcutaneous

tissue over the pectoralis major muscle, supplying the skin and the mammary gland. They are derived from various sources. Some of the nerves, branches of the superficial cervical plexus, descend over the clavicle: others, branches of the intercostal nerves, perforate the intercostal spaces, close to the sternum, each in company with a small artery; a third series, also branches of the intercostal nerves, come out on the side of the chest between the ribs, and run forwards over the outer border of the pectoralis major. These nerves are larger in the female than the male.

The *supra-clavicular*, the cutaneous nerves which descend over the clavicle, are subdivided according to their direction, into *sternal*, *clavicular*, and *acromial* branches.

The *sternal*, one or two in number, and of small size, cross the inner end of the clavicle, to supply the integument over the upper part of the sternum.

The *clavicular*, two or three in number, pass over the centre of the clavicle, and divide into filaments, which supply the integument over the front of the chest and the mammary gland.

The *acromial* branches, the largest, cross over the outer end of the clavicle, and distribute their filaments to the skin of the shoulder.

These several nerves are situated beneath the Platysma as they cross the clavicle, and are occasionally accompanied by small arteries.

3. The nerves which perforate the intercostal spaces, about half an inch from the sternum, will be readily found with the small arteries which accompany them. They are called the *anterior cutaneous branches of the intercostal nerves*. After traversing the fibres of the pectoralis major, each nerve sends a slender filament inwards to the skin over the sternum, and a larger filament outwards, which supplies the integuments over the pectoral muscle. The nerve which perforates the first intercostal space is the smallest. Those perforating the third, fourth, and fifth, are generally the largest, and supply the mammary gland.

The arteries which accompany these nerves are *perforating branches of the internal mammary*. One, or sometimes two, of them are transmitted through each intercostal space. They pass outwards, supplying the pectoral muscle, the skin, and the

mammary gland. The branches destined for the latter are larger than the rest, and, during lactation, increase in size, ramifying tortuously over the surface of the gland: in some instances they have been seen nearly as large as the radial at the wrist.

The cutaneous nerves which run forwards over the outer border of the pectoralis major, are derived from the *lateral cutaneous branches of the intercostal nerves*, which escape between the digitations of the serratus magnus on the side of the chest. They will be more fully described at a future stage of the dissection. (See § 12.)

The superficial fascia must now be removed with the mammary gland from the surface of the pectoralis major, which will be most easily cleaned by dissecting parallel to the course of its fibres. The muscle, like all others, is covered by a thin layer of condensed cellular membrane, which forms its proper fibrous investment, and sends down partitions between the larger bundles of muscular fibres. When the whole surface of the muscle has been fully exposed, observe its shape, the course of its fibres, their origin, and insertion.

4. The *pectoralis major* muscle, somewhat triangular in form, constitutes the prominence on the front of the chest of the male, and the anterior border of the axilla. It is divided into two distinct, but unequal portions, which are separated by a cellular interval. The upper and smaller portion, called clavicular, arises from the anterior surface of the sternal half of the clavicle. The lower and larger portion is attached to the front of the sternum, and to the cartilages of all the true ribs, except the first and the last: in some subjects, also, by a distinct slip to the aponeurosis of the external oblique muscle of the abdomen. Its sternal attachment consists, more especially at its lower part, of aponeurotic fibres, which, interlacing with those of the opposite side, form a fibrous layer in front of the sternum. The several bundles of muscular fibres converge towards the arm, and terminate in a flat tendon, about two inches in breadth, which is inserted into the anterior margin of the bicipital groove of the humerus. Their arrangement, as well as the structure of their tendon, is peculiar. The lower fibres, which are longer than the rest, ascend outwards, and are folded beneath the upper and

middle, so as to terminate upon the higher part of the tendon; whereas the upper fibres descend in an oblique direction, in front of the lower, and terminate upon the lower part of the tendon. Thus the upper and lower fibres of the muscle cross each other previously to their insertion.

The structure of the tendon can be best examined after the muscle is divided. It consists of two distinct layers, placed one in front of the other, and united inferiorly: the anterior layer receives the upper and middle fibres of the muscles; the posterior receives the lower.

The upper border of the posterior layer of the tendon sends off an aponeurotic expansion, which covers the long head of the biceps, and is attached to the great tuberosity of the humerus. The inferior border of the anterior layer is intimately connected with the fascia of the upper arm, and the tendon of the deltoid muscle.

The chief *action* of the pectoralis major is to draw the arm towards the chest: as, for instance, in placing the hand on the opposite shoulder, or in pulling an object towards the body. If the arm be elevated, and made the fixed point, the muscle will assist in raising the trunk, as in climbing. The peculiar arrangement of the muscular fibres, which we have noticed, serves the purpose of enabling all parts of the muscle to act simultaneously when the arm is extended.

Between the pectoralis major and the deltoid, the great muscle of the shoulder, there exists a *cellular interval* varying in extent in different subjects, but always more marked towards the clavicle. This fissure corresponds pretty nearly to the direction of the axillary artery. It contains a small artery—the *thoracica-humeraria*—and the *cephalic vein*, which, ascending along the outer side of the arm, empties itself into the axillary vein. In this interval, also, are usually found one or more small absorbent glands, called *infra-clavicular*: they receive the absorbent vessels which accompany the cephalic vein. These glands are situated most frequently near the clavicle, but are observed occasionally several inches lower down along the course of the vein.

5. ANATOMY OF THE INFRA-CLAVICULAR REGION.—Reflect from the clavicle the clavicular portion of the pectoralis major. Care

should be taken not to divide a small artery and nerve which enter its under surface. The artery comes from the thoracic axis, and the nerve is a thoracic branch of the brachial plexus. Beneath the reflected portion of the muscle will be observed a tolerably compact fascia, which is attached to the clavicle, separates the two pectoral muscles, and is continuous below with the fascia of the axilla. Remove this fascia, together with some subjacent fat and cellular tissue, and part of the pectoralis minor will be exposed. Between the upper border of this muscle and the clavicle there exists an important space, in which the following objects will be observed :—

- a. A strong ligamentous expansion, called the costo-coracoid ligament, which extends from the cartilage of the first rib to the clavicle.
- b. The axillary vein, artery, and plexus of nerves.
- c. The subclavius muscle enclosed in its fibrous sheath.
- d. A short arterial trunk, called the thoracic axis, which appears above the pectoralis minor, and divides into several branches, which take different directions.
- e. The termination of the cephalic vein in the axillary.
- f. Two or three nerves, called the anterior thoracic, which descend from the axillary plexus beneath the clavicle, cross in front of the axillary vessels, and subdivide into numerous filaments to supply the pectoral muscles.

These several objects must be carefully dissected and examined in detail.

6. The *costo-coracoid ligament or fascia* varies in density in different individuals. It extends from the cartilage of the first rib to the coracoid process, and between these two points it is attached to the clavicle, and forms a complete investment for the subclavius muscle. In front the ligament presents a crescent-shaped margin which arches over, and protects the axillary vessels and nerves : from this margin a fascia is prolonged, which accompanies the vessels into the axilla, enclosing them in a kind of sheath, especially strong on the inner side of the vein. This fascia must necessarily be divided before the axillary vessels can be exposed.

7. Immediately above the upper border of the pectoralis minor

is seen a branch of the axillary artery, called the *thoracic axis*. It is a short thick trunk, which divides into several branches. One of these, called the *superior* or *short thoracic*, runs along the upper border of the pectoralis minor, between the two pectoral muscles, supplying ramifications to both, to the mammary gland, and inosculating with the intercostal and internal mammary arteries. A second branch, called the *thoracica humeraria*, descends by the side of the cephalic vein, in the groove between the pectoralis major and deltoid muscles, and ramifies in both. A third, the *thoracica acromialis*, passes over the coracoid process to the under surface of the deltoid, where it divides into several ramifications, some of which supply the deltoid muscle, communicating with the circumflex branches of the axillary artery; others, piercing the deltoid, maintain upon the upper surface of the acromion process an intricate anastomosis with corresponding branches of the suprascapular and circumflex arteries. A fourth small branch occasionally proceeds inwards to the clavicle and subclavius muscle. All these arteries are accompanied by veins, which most frequently empty themselves into the cephalic previous to its termination in the axillary, but occasionally into the axillary vein itself.

8. The *cephalic vein* is one of the principal trunks formed by the cutaneous veins of the arm, the shoulder, and the chest. Commencing by roots from the dorsal surface of the thumb and forefinger, it passes superficially along the radial side of the fore-arm over the front of the elbow-joint; thence ascending along the outer edge of the biceps muscle, it runs up the interval between the pectoralis major and deltoid muscles to reach the upper border of the pectoralis minor, where it crosses the axillary artery, and terminates in the axillary vein.

In the space now before us we observe the *great vessels and nerves of the axilla* in the first part of their course. Their depth from the surface will mainly depend upon the extent to which the clavicle projects. They are closely surrounded by a sheath of fascia, which descends with them beneath the clavicle, and are situated with regard to each other in the following manner. The axillary vein is the very large venous trunk in front of the artery, and rather to its sternal side; the vein, if distended, will partially con-

ceal the artery. The vessels are not in absolute contact, but separated by a thin membranous septum, derived from the costocoracoid fascia. The plexus of nerves is situated above the vessel, and on a plane posterior to it. The plexus consists of two or sometimes three large cords, which result from the union of the anterior branches of the four last cervical nerves and the first dorsal.

9. The small nerves which cross more or less obliquely over the axillary artery immediately below the clavicle are called the *anterior thoracic* nerves. They arise from the front of the axillary plexus, beneath the clavicle, and supply the pectoral muscles. Two of them, branches of the fifth and sixth cervical, generally cross in front of the axillary artery and vein, and distribute their filaments along the under surface of the pectoralis major, in company with the branches of the thoracic axis which supply the muscle. A third, most commonly a branch of the eighth cervical, runs underneath the artery, and then coming forwards between it and the vein, communicates with one of the nerves in front, so as to form a kind of loop round the vessel. Its filaments enter the under surface of the pectoralis minor in company with an artery: one or two of them pass through the muscle to supply the pectoralis major.

A slender filament from the anterior thoracic nerves may sometimes be traced to the sternal joint of the clavicle, and another to the acromial joint.

10. The muscle which lies beneath the clavicle enclosed in a strong sheath is the *subclavius*. Open the sheath by an incision parallel to the clavicle, in order to expose the muscle. It arises from the junction of the cartilage with the osseous portion of the first rib by a round tendon, which extends for some distance along the inferior surface of the muscle. The fleshy fibres ascend over the subclavian vessels, and are *inserted* into a groove on the under surface of the clavicle as far outwards as the coraco-clavicular ligament.

The *action* of this muscle is to depress the clavicle, and prevent its too great elevation.

The *nerve to the subclavius* is a small branch of the brachial plexus. It usually comes from the fifth cervical nerve, runs in

front of the subclavian artery, and enters the centre of the muscle.

A small *bursa mucosa* is in some subjects found between the tendon of the subclavius and the first rib.

From the view which has been obtained of the relations of the axillary artery in the first part of its course, some idea may be formed of the difficulty of passing a ligature round the vessel in this situation. In addition to the ordinary obstacles, varieties sometimes occur in the position of the nerves and veins, which would render the operation still more embarrassing. For instance, the anterior thoracic nerves may be more numerous than usual, and form by their mutual communications a kind of plexus round the artery. It sometimes happens that a large nerve crosses obliquely in front of the artery immediately below the clavicle, and subsequently forms one of the roots of the median nerve.

The cephalic vein may ascend higher than usual, and open into the subclavian; and, since it frequently receives large veins corresponding to the thoracic arterial axis, a concourse of veins would in such cases be met with in front of the axillary artery.

Again, it is by no means uncommon to find one or more deeper-seated veins, which cross directly over the artery to join the axillary vein.

DISSECTION OF THE AXILLA.

Prolong the incision down the upper third of the arm, and reflect the skin from the axilla and from the side of the chest, taking care not to remove with it the dense subjacent membrane. In close contact with the skin, near the roots of the hair in the axilla, will be observed numerous sebaceous glands. They are of a reddish-brown colour, and rather larger than a pin's head.

11. The tough unyielding membrane which lies immediately beneath the skin of the axilla, is nothing more than a continuation of the general investment of the muscles. On account of its compactness, it has received the name of *the axillary fascia*.

This fascia closes in and forms, as it were, the floor of the cavity of the axilla. Externally it is intimately connected with the

tendons of the pectoralis major and latissimus dorsi, and between them it is continuous with the fascia on the inner side of the arm. Internally it is prolonged on the side of the chest, over the serratus magnus muscle. In front and behind, the fascia divides so as to enclose between its layers the respective muscles which form the anterior and posterior boundaries of the axilla. Thus the anterior layer is continued upwards beneath the two pectoral muscles, and is connected with the coracoid process, the costo-coracoid ligament, and the clavicle. The posterior layer, enclosing the latissimus dorsi muscle, passes backwards to the spines of the dorsal vertebræ.

12. Remove the axillary fascia. An artery, sometimes of considerable size, is often observed in its substance; it generally arises from the brachial, or, perhaps, the lower part of the axillary, and runs forwards across the floor of the axilla, and along the lower edge of the pectoral muscle. Though simply a subcutaneous artery, it might occasion considerable haemorrhage if wounded in opening an abscess. The axilla contains a chain of absorbent glands, with a number of arteries, veins, and nerves, forming an intricate plexus, embedded in loose cellular tissue and fat. This cellular tissue should be broken down with the handle of the scalpel, in order to discover the nerves which cross from the ribs towards the posterior border of the axilla. These nerves are called the *lateral cutaneous branches of the intercostal nerves*; they perforate obliquely the intercostal spaces between the digitations of the serratus magnus, nearly midway between the sternum and the spine, each in company with a small branch of the corresponding intercostal artery, and then divide into anterior and posterior branches. The *anterior* turn over the pectoralis major, to supply the skin on the front of the chest and the mammary gland. The *posterior* pass backwards over the latissimus dorsi, and are distributed to the skin covering this muscle and the scapula.

13. The *perforating branch of the second intercostal nerve* requires a special description; it is much larger than the others, and is called the *intercosto-humeral nerve*, from its supplying the integuments of the arm. It comes through the second intercostal

space, close to the lower border of the second rib, above the third digitation of the serratus magnus, traverses the upper part of the axilla, where it receives a branch of the lesser internal cutaneous nerve, (nerve of Wrisberg, from the brachial plexus,) and perforating the fascia, terminates in numerous filaments, which are distributed to the skin, on the inner and posterior aspect of the arm, as low as the internal condyle. Before it leaves the axilla, this nerve sends a branch which turns round the latissimus dorsi, to supply the integument over the dorsum of the scapula.

The *perforating branch of the third intercostal* is also an *intercosto-humeral* nerve. It almost always receives a branch from the second, and has a somewhat similar distribution, except that its filaments do not extend so low down the arm.

14. The *axilla* may be described as a space, of somewhat conical form, of which the summit is beneath the clavicle, and the base between the pectoralis major and latissimus dorsi muscles. On the *inner* side, the axilla is bounded by the four or five upper ribs, covered by the serratus magnus muscle; on the *outer* side by the humerus, covered by the coraco-brachialis and biceps muscles; in front by the pectoralis major, and behind by the latissimus dorsi, teres major, and subscapularis muscles. Its anterior and posterior boundaries converge from the chest, so that the axilla becomes gradually narrower towards the arm.

This space, of which the dimensions vary with the position of the arm, is occupied by loose cellular tissue and fat, and by numerous *absorbent glands*, which form a continuous chain beneath the clavicle, with the cervical glands. They are from ten to twelve in number, of a reddish brown colour and variable size. Most of them lie in the immediate neighbourhood of some large blood-vessel; others are embedded promiscuously in the loose cellular tissue of the axilla, and sometimes one or two small ones are observed along the lower border of the pectoralis major, immediately beneath the skin. They are well supplied with blood by a special branch (*thoracica alaris*) of the axillary artery, as well as by numerous ramifications from the thoracic and infrascapular arteries.

These glands receive the absorbents from the arm, from the front

and side of the external parts of the chest, and from the outer half of the mammary gland.

The absorbent vessels which enter the glands, (*vasa inferentia*) are more numerous, but smaller than those which leave them (*vasa efferentia*). After forming a plexus around the subclavian vein, the latter vessels unite into a single trunk, which empties its contents on the left side into the thoracic duct, and on the right into the subclavian or internal jugular vein. The glands may be removed in order to expose other important objects.

The *great axillary vessels and nerves* occupy the upper part of the axilla, the axillary vein being the most conspicuous. A large artery is usually found on the side of the chest along the lower border of the pectoralis minor; it is the *inferior or long thoracic branch* of the axillary. Along the posterior border of the axilla will be seen another large artery, accompanied by a nerve, both called the *infra-scapular*, from their position.

Thus an artery of considerable size runs parallel with, and close to the anterior and posterior border of the axillary space; a point to be remembered in opening abscesses, or performing other operations in the axilla.

The broad flat muscle which covers the side of the chest between the ribs and the scapula, is called the *serratus magnus*, from the tooth-like appearance of its attachment to the eight superior ribs. Its fibres, converging, are inserted into the whole length of the posterior border of the scapula. This muscle, as well as others connected with the scapula, will be more fully examined hereafter.

15. On the external surface of the serratus magnus, observe a *large nerve called the posterior thoracic* (external respiratory of Bell).

This nerve, remarkable for the length of its course, is derived by two roots from the fifth and sixth cervical nerves, close to the transverse processes of the cervical vertebræ. Descending almost vertically behind the axillary vessels and nerves, it reaches the upper border of the serratus magnus, and runs down the external surface of this muscle to which its filaments are exclusively distributed,—each digitation usually receiving a separate filament.

The pectoralis major must now be divided midway between its

origin and insertion, and both ends reflected. After the reflection of the muscle, the peculiar arrangement of its fibres, and the structure of its tendon, should be more fully examined. (See § 4.)

On its under surface will be seen the branches of the thoracic arteries and nerves, which have been already described, § 7. The smaller arterial ramifications may be divided, but the main branches from which they arise should be preserved.

16. The *pectoralis minor* muscle, now exposed, *arises* by imperfect digitations from the osseous part of the third, fourth, and fifth ribs (not infrequently from the second), and sometimes from the glistening fascia covering the intercostal muscles. The fleshy fibres proceed upwards and outwards, and converge to a strong tendon, which is *inserted* into the anterior surface of the coracoid process of the scapula. This tendon is generally connected by a strong fascia to the upper part of the coraco-brachialis muscle; forming as it were a protection to the subjacent axillary vessels and nerves. A few of the lower fibres of the muscle are inserted into this fascia. The *action* of this muscle is to draw the scapula downwards and forwards.

In some instances a small *bursa* is found between the tendon of the *pectoralis minor* and the coracoid process.

The great muscle which forms the posterior margin of the axilla is the *latissimus dorsi*. Its extensive origin from the back cannot be seen. For present purposes, it is sufficient to notice its broad flat tendon, which passes behind the axillary vessels and nerves, and is inserted into the bicipital groove of the humerus.

Immediately behind the *latissimus dorsi*, and closely connected with it, is a muscle called the *teres major*, which also assists in forming the posterior boundary of the axilla. Its fleshy fibres *arise* from the lower angle of the dorsum of the scapula, pass nearly parallel to the *latissimus dorsi*, and terminate in a very broad tendon, which is *inserted* into the posterior margin of the bicipital groove of the humerus.

The muscle which occupies the internal surface of the scapula is called the *subscapularis*. It *arises* from the internal surface of the scapula, and terminates in a strong flat tendon, which passes under the axillary vessels and nerves, over the inner side of the

shoulder-joint, and is *inserted* into the lesser tuberosity of the humerus.

The two muscles which are attached to the coracoid process of the scapula, and descend perpendicularly along the inner side of the arm, are the *coraco-brachialis* and *short head of the biceps*.

Along the upper border of the pectoralis minor runs an artery,—the superior, or short thoracic; another, larger than the former, runs near the lower edge of the muscle, and is called the inferior, or long thoracic. They are both branches of the axillary.

Reflect the pectoralis minor from its origin, without dividing the thoracic arteries, and the cavity of the axilla will be completely exposed. The great vessels and nerves should be carefully cleaned, without disturbing their connexions. It is advantageous partially to reflect the subclavius from its attachment to the rib and the clavicle, in order to obtain a full view of the axillary plexus and vessels.

17. COURSE AND RELATIONS OF THE AXILLARY VESSELS AND NERVES.—The *axillary vessels* and *plexus of nerves* are closely covered by a thin layer of the cervical fascia, which descends with them beneath the clavicle. The direction of their course will necessarily vary with every position of the arm. The following description supposes the subject to be placed on the back, with the arm at nearly a right angle with the body. The main artery of the arm passes beneath the clavicle over the upper surface of the first rib, and is called the *subclavian* till it reaches the lower border of the rib, where it takes the name of *axillary*. These limits are merely arbitrary, and adopted for the convenience of description. From the margin of the rib the *axillary artery* proceeds obliquely downwards and outwards through the upper part of the axilla, beneath the two pectoral muscles, and along the inner edge of the coraco-brachialis muscle to the lower border of the tendon of the teres major muscle, where it takes the name of *brachial*. Thus the vessel crosses the apex of the axilla, and descends along its humeral side. In its course downwards, the artery lies successively over the first intercostal space and the second digitation of the serratus magnus; next upon the loose cellular tissue of the axilla; then upon the subscapularis muscle; and, lastly, upon the tendon of the latissimus dorsi and teres major.

The *axillary vein* in the first part of its course lies in front of

the artery, and to its sternal side : in the lower two-thirds of the axilla the vein still lies to the sternal side of the artery, but is separated from it by the nerves.

The axillary plexus, consisting of two or three large nerves, is at first situated above the artery, and on a plane posterior to it ; but the nerves, as they descend, come into closer connexion with the artery, and subdivide in such a way, that, upon the tendon of the subscapular muscle the vessel is surrounded on every side by the interlacement of the nerves.

18. The *axillary* or *brachial plexus* is formed by the anterior branches of the four lower cervical nerves and the first dorsal. The plexus is broad at the lower part of the neck, where it appears between the scaleni muscles ; but it gradually contracts as it descends beneath the clavicle, and across the apex of the axilla. The arrangement of the nerves in the formation of the plexus is by no means constant, and often dissimilar on both sides of the body. Most frequently the fifth and sixth cervical descend obliquely outwards, and unite to form a single large cord : the eighth cervical and the first dorsal also unite to form another ; the seventh cervical runs for some distance alone, and then divides, so as to unite with the two other cords. Thus, the plexus, which at its commencement presents three large nerves, consists at the lower border of the first rib of only two ; the one being situated behind the axillary artery, the other above it, and on its acromial side.

These two large nerves, by their subdivisions, form a plexus round the axillary artery, where it lies upon the tendon of the subscapularis, and give off the nerves to the arm in the following manner :—

The *median nerve* arises by two roots, which lie in front of the artery, and converge like the branches of the letter V. On the *outer side* of the artery is the external root of the median, and the external cutaneous nerve ; on its *inner side* is the internal root of the median, the ulnar, and the internal cutaneous : *behind* the artery is the circumflex, and the musculo-spiral or radial nerve.

From this arrangement there are occasional deviations. For instance, the two roots of the median may embrace the artery, higher up in its course, or lower down than usual : or both its roots may lie behind the artery.

A deviation, one which was observed once only in 300 arms, may occur, in which all the nerves are situated above the artery, and on its acromial side, the vessel being entirely free in the whole of its course.

19. Replace the pectoralis minor, for the purpose of tracing the *branches of the axillary artery*. Their number and origin frequently vary, but their general course is in most cases similar; they usually arise from the axillary trunk in the order in which they are here described:—

The *thoracic axis* arises above the pectoralis minor, and divides into branches which have been already noticed, § 7.

The *inferior or long thoracic artery*, sometimes called the external mammary, descends almost vertically along the inferior border of the pectoralis minor. Its numerous ramifications supply the mammary gland, the serratus magnus and pectoral muscles, and maintain a free anastomosis with the branches of the superior thoracic, the internal mammary, and intercostal arteries. It sometimes arises by a common trunk with the following:—

20. The *infra-scapular artery* is the largest branch of the axillary; it arises opposite the lower border of the subscapular muscle, parallel to which it descends, and about one inch and a half from its origin, divides into an *anterior* and a *posterior* branch.

The *anterior branch* appears like the continued trunk; it takes rather a tortuous course along the anterior edge of the subscapularis muscle towards the inferior angle of the scapula. The numerous branches given off by this artery supply the subscapular, the latissimus dorsi, and serratus magnus muscles, and anastomose with the intercostal and thoracic arteries, as well as the posterior scapular (a branch of the subclavian).

The *posterior branch* (*dorsalis scapulæ*), larger than the preceding, turns round the lower border of the subscapularis, through a triangular opening bounded by the long head of the triceps, the teres major, and subscapularis muscles. Having reached the dorsum of the scapula, it divides into several branches, which ramify close upon the bone, supplying the infra-spinatus and teres minor muscles, and inosculating with the supra and posterior scapular arteries. The *dorsalis scapulæ* sends off a small branch, which ramifies in the sub-

scapular muscle. The *infra-scapular vein* lies in front of its corresponding artery, and empties itself into the axillary vein.

21. Three *nerves*, called the *subscapular*, are found on the surface of the subscapularis muscle. They come from the posterior part of the axillary plexus, and supply respectively the latissimus dorsi, teres major, and subscapularis. The *nerve for the latissimus dorsi*, commonly called the *long subscapular*, is seen in company with the anterior branch of the infra-scapular artery. It runs behind the axillary vessels, and crosses obliquely the infra-scapular artery to reach the internal surface of the latissimus dorsi, which it enters by two or three branches. The long subscapular very rarely sends filaments to the serratus magnus.

The *nerve for the teres major* muscle is either a branch of the preceding, or a distinct one from the plexus. It lies nearer to the humerus than the long subscapular, and enters the upper surface of the muscle.

The proper *nerve for the subscapular muscle* arises from the plexus higher than the others, and enters the upper and posterior part of the muscle. Sometimes two or even more separate nerves are distributed to this muscle, especially in those instances in which it is divided by well-marked tendinous septa.

The origin of the subscapular nerves is apt to vary. The nerve for the teres major may be a branch of the long subscapular, or both may be derived from the circumflex nerve.

22. There are two *circumflex arteries*—an *anterior* and a *posterior*, so called from the manner in which they encircle the neck of the humerus. The *posterior circumflex artery* is nearly as large as the infra-scapular, close to which it is given off; or they may both arise by a common trunk from the axillary. It passes backwards through a quadrilateral opening, bounded above by the subscapularis muscle, below by the teres major, externally by the neck of the humerus, and internally by the long head of the triceps. It then winds round the back of the neck of the humerus, and reaches the under surface of the deltoid muscle, to which it is principally distributed.

This artery, in its course, supplies the long head of the triceps, the head of the humerus, and the capsule of the shoulder-joint. It

inosculates above with the acromial thoracic artery, below with the ascending branch of the superior profunda (a branch of the brachial), and in front with the anterior circumflex artery. In some instances, the posterior circumflex is a branch of the brachial, and ascends behind the tendons of the latissimus dorsi and teres major muscles to reach the deltoid.

The posterior circumflex artery is accompanied by the *circumflex nerve*, which will be found behind the axillary artery. This large nerve comes from the posterior part of the brachial plexus, in common with the musculo-spiral, and, after sending a branch to the subscapularis muscle, and another to the teres minor, terminates in the under surface of the deltoid. The nerve supplies, also, the skin covering the deltoid by one or more branches, which turn round the posterior border of the muscle, and subdivide into smaller filaments: one or two slender ones sometimes perforate the muscle to reach the skin.

The circumflex nerve sends small filaments to the capsule of the shoulder-joint, and to the head of the humerus through the foramina in the bone.

23. The *anterior circumflex artery*, a branch of the axillary, is very much smaller than the posterior, and will be found covered by a thin layer of fascia, in front of the neck of the humerus, immediately above the tendon of the latissimus dorsi. It proceeds directly outwards beneath the coraco-brachialis and short head of the biceps, close to the bone, and terminates in the under surface of the deltoid, where it inosculates with the posterior circumflex artery.

The most remarkable branch of the anterior circumflex artery, and one of the most constant in the body, is that which runs with the long tendon of the biceps up the groove of the humerus. It is called, on that account, the bicipital artery; it supplies the shoulder-joint, and gives off numerous branches, which form a plexus on the periosteum over the neck of the humerus, and penetrate the foramina in the bone. Branches from the anterior circumflex descend to inosculation with ascending branches of the superior profunda.

The *alar thoracic artery* is a small branch, variable in its origin.

It may come from the axillary, or the infra-scapular, or the inferior thoracic. It ramifies in the cellular tissue of the axilla, supplying the axillary glands.

24. The *axillary vein* is formed by the junction of the *venæ comites* of the brachial artery, near the anterior border of the subscapularis muscle. It receives the subscapular and the other veins corresponding to the branches of the axillary artery, with the exception of the circumflex, which usually join, either the subscapular, or one of the *venæ comites*. The axillary also receives the cephalic, and sometimes the basilic veins.

DISSECTION OF THE UPPER ARM.

25. Let the incision through the skin be continued down the arm over the front of the elbow to about two inches below it. Reflect the skin from the front and sides of the arm without removing the adipose and cellular tissue in which the subcutaneous nerves and veins ramify. The cutaneous nerves which perforate the fascia on the inner side of the arm are branches of the intercosto-humeral, and the greater and lesser internal cutaneous nerves.

The filaments of the *intercosto-humeral nerves* may be traced down the inner and posterior part of the arm to the olecranon.

The branches of the *internal cutaneous nerve*, two or more in number, perforate the fascia in one or two places about the middle of the inner side of the arm, and subdivide into two sets of filaments, of which the one supplies the anterior, the other the posterior surface of the fore-arm.

The *lesser internal cutaneous*, or *nerve of Wrisberg*, perforates the fascia about the lower third of the arm, and ramifies over the internal condyle and olecranon. All these cutaneous nerves have frequent communications with each other.

The *internal cutaneous branch of the musculo-spiral nerve* is sometimes wanting, and always small. It is usually accompanied by a small artery, and pierces the fascia near the middle of the inner side of the arm.

The nerves, one or more, which perforate the fascia near the middle of the outer part of the arm, are the *external cutaneous branches of the musculo-spiral*. They are generally accompanied by a small artery from the superior profunda. They divide into numerous filaments, one or more of which will be traced down the outer and back part of the forearm to the wrist.

In some instances this nerve sends cutaneous filaments upwards and downwards in company with the cephalic vein.

On the outer side of the tendon of the biceps, immediately above the elbow-joint, the *external cutaneous* nerve perforates the fascia, and divides into many branches, which supply the skin of the outer part of the forearm.

26. The next object of attention should be the *disposition of the veins in front of the elbow*, where venesection is usually performed. In cleaning these veins, great care should be taken not to divide the branches of the internal and external cutaneous nerves which pass both above and below them.

The following is the ordinary arrangement of the superficial venous plexus at the bend of the elbow, but it is subject to frequent varieties:—On the outer side of the fore-arm is the radial, and on the inner side is the ulnar vein; in the centre is a third, called the median, which divides into two branches; the external one, which unites with the radial to form the cephalic vein, is called the median cephalic; the internal one, which unites with the ulnar to form the basilic, is named the median basilic vein. Near the point of its bifurcation, the median vein communicates by one or more branches with the deep veins which accompany the arteries of the forearm.

Trace the *cephalic vein* up the arm. It runs superficially along the outer border of the biceps to the groove between the pectoralis major and the deltoid muscles, where it terminates in the axillary.

The *basilic vein* ascends along the inner side of the arm in company with the internal cutaneous nerve, which usually lies close to its outer side. Near the middle or the upper third of the arm, it perforates the fascia, and empties itself either into the internal vena comae of the brachial artery or into the axillary vein. In their course along the upper arm, the basilic and cephalic receive num-

rous cutaneous veins, and the basilic has frequent communications with the deep brachial veins.

27. *The relative position of the internal and external cutaneous nerves with regard to the veins* at the bend of the arm is subject to some irregularity. Most commonly the trunks of the nerves pass beneath the veins, but often, though the principal branches go beneath the vessels, many small filaments cross in front of them which are exposed to injury in venesection.

The internal cutaneous nerve certainly passes more frequently superficial to the vein than the external. The external cutaneous nerve has been seen passing through a distinct foramen in the median cephalic vein.

Since the median basilic vein is generally larger than the median cephalic, and, on account of the strong fascia beneath, more easily compressible, it is usually chosen for venesection: its position, therefore, in reference to the brachial artery, becomes very important. The vein crosses obliquely in front of the artery, from which it is only separated by the fascia derived from the tendon of the biceps. This fascia is in some subjects remarkably thin, or it may be altogether wanting.

It sometimes happens that the brachial artery, or the radial, lies above the fascia, in absolute contact with the median basilic vein. In choosing, therefore, this vein for venesection, there is a risk of wounding the artery: hence the practical rule, to bleed either from the median cephalic, or at any rate from the median basilic above or below the situation where it crosses the brachial artery.

Immediately above the internal condyle, in the neighbourhood of the basilic vein, are usually found one or two small *subcutaneous absorbent glands*. One or two others may lie higher up along the inner side of the arm. A superficial gland has also been seen at the bend of the elbow: none are found below this joint. These little glands on the inner side of the arm are generally the first which become tender and enlarged after an injury to the hand.

Remove the superficial fascia in order to examine the proper investing fascia of the upper arm. Preserve the chief cutaneous veins and nerves.

28. *The dense aponeurosis which invests the upper arm* may be

considered as a continuation of the fascia from the trunk and the axilla ; it is composed of circular fibres, intersected by others which have a vertical direction. This membrane varies in density : thus it is thin over the biceps muscle, stronger on the inner side of the arm, for the purpose of protecting the brachial vessels and nerves, and strongest over the triceps muscle. At the upper part of the arm the fascia is connected with the coracoid process and coraco-clavicular ligament : it is strengthened as it descends by an expansion from the tendons of the pectoralis major and latissimus dorsi : posteriorly it is firmly attached to the spine of the scapula and to its axillary border. The fascia surrounds the brachial vessels with a sheath, and sends off prolongations to separate the muscles from each other. Of these processes the most marked are those called the *external* and *internal intermuscular septa*, which divide the muscles on the anterior from that on the posterior surface of the upper arm. These septa are attached to the projecting ridges on either side of the humerus and to the condyles. The *internal septum*, the most prominent of the two, begins at the insertion of the coraco-brachialis, and separates the triceps extensor from the brachialis anticus muscles. The *external septum* commences from the insertion of the deltoid, and separates the brachialis anticus, the supinator longus, and the extensor carpi radialis longior in front, from the triceps behind.

At the lower part of the upper arm the fascia is remarkably strong, especially where it covers the brachialis anticus and the brachial vessels, and is continued over the muscles on the inner side of the forearm. At the back of the elbow, the fascia is attached to the tendon of the triceps and the olecranon.

The fascia must now be removed from the surface of the muscles, to which it is united by a very loose cellular tissue, which allows them to move freely beneath it. The nerves which pass through the fascia should be preserved.

The three muscles on the front of the arm should next be examined : these are, the biceps in front, above and on its inner side the coraco-brachialis, and beneath it the brachialis anticus.

29. The *biceps* is the long delicate-looking muscle which forms

the prominence on the front of the arm : as its name implies, it has two distinct origins or heads—a long and a short. The *short head of the biceps*, the most internal of the two, is attached to the point of the coracoid process of the scapula, by means of a flat tendon, from the posterior surface of which the fleshy fibres arise. This tendon is common to a slender muscle on its inner side, called the coraco-brachialis. The *origin of the long head* of the biceps cannot at present be seen ; it takes place from the upper border of the glenoid cavity of the scapula by a long flat tendon, which traverses the shoulder-joint and passes over the head of the humerus, and between the two tuberosities. The tendon is retained in the groove by a strong fibrous expansion, derived from the capsule of the joint, and connected with the tendon of the pectoralis major. By dividing this expansion, it will be found that the synovial membrane of the joint is reflected round the tendon, and accompanies it for about two inches down the groove, thus forming a sort of synovial fold, between the layers of which small ramifications of the anterior circumflex artery run up to supply the tendon. The long tendinous head expands as it descends, and gives origin to the muscular fibres from its under surface. The two heads unite about the middle of the arm, or, perhaps, its inferior third, and form a single muscle, which terminates a little above the elbow-joint in a strong flat tendon of considerable length, which sinks deep into the triangular space at the bend of the elbow, and, after a slight twist upon itself, is *inserted* by a broad expansion into the posterior part of the tubercle of the radius. The anterior part of the tubercle, over which the tendon plays, is crusted with fibro-cartilage, and a large *bursa mucosa* intervenes to facilitate its motion. The most internal fibres of the muscle are connected with a *very strong broad aponeurosis, of a semilunar form*, which is prolonged from the inner border of the tendon obliquely downwards and inwards to the fascia of the forearm. This aponeurosis, commonly called the *semilunar fascia of the biceps*, protects the brachial vessels and the median nerve at the bend of the elbow.

At the upper part of the arm the two heads of the muscle are separated from each other by an interval, which will vary in extent

in proportion to the degree in which the humerus is rotated outwards. On the other hand, when the humerus is rotated inwards, the short head rather overlaps the long one. The action of the biceps is to bend the forearm. The insertion of its tendon into the posterior part of the radius gives it the power of supinating the hand,—a power which is greatly increased when the arm is bent.

30. The *coraco-brachialis* is a thin muscle, situated at the upper part of the arm, and runs parallel to the inner border of the short head of the biceps. It *arises* by fleshy fibres from the point of the coracoid process, in common with the short head of the biceps, and from a fibrous septum which lies between them. The muscle descends on the outer side of the brachial vessels and nerves, and terminates in a flat tendon, which is *inserted* into the inner side of the humerus, about its middle, between the brachialis anticus and the inner head of the triceps. This tendon is intimately connected with the internal intermuscular septum.

The coraco-brachialis is usually perforated from above downwards by the external cutaneous nerve.

This muscle and the biceps are covered at their upper part by the deltoid and great pectoral muscles. The head of the humerus rolls beneath the coraco-brachialis and short origin of the biceps, and a large *bursa mucosa* is usually interposed between these muscles and the tendon of the subscapularis, which covers the head of the bone. From the outer side of the coraco-brachialis a strong aponeurosis is prolonged beneath the deltoid over the shoulder-joint. Not infrequently some of the muscular fibres of the coraco-brachialis are inserted into the fascia, which covers the brachial artery in the centre of the arm. The *action of the muscle* is to draw the arm forwards and inwards towards the chest.

31. The *brachialis anticus*, partly concealed by the biceps, is situated along the front of the lower half of the humerus in close contact with the bone. To see the muscle the biceps must be raised by dissecting along its outer border. Between the two muscles will be found a layer of fascia and the external cutaneous nerve, of which the muscular branches must be preserved.

It *arises* about the middle of the humerus by a fleshy digitation

on either side the tendon of the deltoid, from the whole of the front surface of the bone below this point, and from the intermuscular septa. The muscle, necessarily becoming thicker and broader as it descends, covers the inner two-thirds of the front surface of the capsule of the elbow-joint, and terminates in a tendon, which appears on its anterior surface, and is *inserted* in a pointed manner into a rough surface below the coronoid process of the ulna.

Some of its deep muscular fibres are intimately connected with the capsule of the elbow-joint.

The tendon of the muscle is strongest on its external side, and gives origin to the fascia on the outer side of the forearm.

Its *action* is to bend the forearm.

32. THE COURSE AND RELATIONS OF THE BRACHIAL VESSELS AND NERVES should now be examined.

The *brachial artery*, a continuation of the axillary, takes its name at the lower border of the teres major muscle. It passes down the inner side of the arm, along the inner border of the coraco-brachialis and biceps muscles, to a triangular space in front of the elbow, where it divides into the radial and ulnar arteries.

Thus its direction corresponds with a line drawn from the anterior part of the axilla to the central point between the condyles of the humerus.

In the upper part of its course it is supported by the triceps muscle, (from which it is separated by the musculo-spiral nerve and superior profunda artery) : in the middle of the arm, it lies on the tendon of the coraco-brachialis, close to the bone ; and in the lower part of its course it rests on the brachialis anticus.

The artery is accompanied by two veins, called the *venæ comites*, and the great median nerve, all of which are invested in a common sheath of fascia. The median nerve generally crosses very obliquely in front of the artery, lying near the axilla on the outer side, and near the elbow on the inner side of the vessel.

The ulnar nerve, situated internally, diverges from the artery as it descends, and is separated from it below by the internal intermuscular septum. Superficial to the artery, we find the internal

cutaneous nerve and the basilic vein, but both lie in some instances on its inner side. It should be particularly observed that the artery is more or less overlapped, in the first part of its course by the coraco-brachialis,—and lower down by the fleshy belly of the biceps; both of these muscles in their respective situations being the best guides to the vessel.

About the middle of the humerus, the artery lies to the extent of nearly two inches on the tendon of the coraco-brachialis, and is so close to the bone that it can here be effectually compressed; in this situation it is usually crossed very obliquely by the median nerve.

At the bend of the elbow the artery is protected by the strong aponeurotic expansion derived from the tendon of the biceps. It enters a triangular space, bounded by two of the muscles of the forearm, namely, by the pronator radii teres internally, and by the supinator radii longus externally. It sinks into the space, with the tendon of the biceps, to its outer side, and the median nerve to its inner side, and all three rest upon the brachialis anticus muscle. Opposite the coronoid process of the ulna it divides into the radial and ulnar arteries.

Two veins, of which the internal is usually the larger, lie in close contact with the brachial artery, and communicate at frequent intervals by transverse branches, sometimes in front of, sometimes behind the artery.

33. Previous to the examination of the branches of the brachial artery, it is advantageous to trace the trunks of the nerves of the upper arm, which are derived from the brachial plexus, near the tendon of the subscapularis.

The *median nerve* arises from the plexus by two roots, which converge in front of the axillary artery. The external root is derived from a trunk in common with the external cutaneous nerve, the internal root from a trunk in common with the ulnar and internal cutaneous nerve. In its course down the arm, the nerve is situated at first on the outer side of the brachial artery, between it and the coraco-brachialis muscle: about the middle of the arm the nerve crosses obliquely over the vessel, or perhaps beneath it, so that at the bend of the elbow it is found on the inner side of the artery, covered by the semilunar fascia from the biceps.

The median nerve does not supply any of the muscles in the upper arm, but it usually receives a branch from the external cutaneous about the middle of its course.

There are certain *varieties* relating to the roots of the median nerve, and its course in regard to the artery, with which it is necessary to be acquainted.

a. The roots may be increased in number by one on either side of the artery : or the internal root may be deficient.

b. They may vary in their position with regard to the artery ; both may be situated behind the vessel, or one behind, and the other in front of it.

c. The nerve, formed in the usual manner, may be joined lower down by a large branch from the external cutaneous ; such a case presents a junction of two large nerves in front of the brachial artery, in the middle of the arm.

d. The nerve in many cases crosses under, instead of over the artery.

e. The nerve sometimes runs parallel and external to the artery ; or it may run parallel to, and in front of the artery.

In one hundred arms, the relative position of the nerve to the artery in its course down the arm was as follows :—

In 72, the nerve took the ordinary course.

„ 20, the nerve crossed obliquely under the artery.

„ 5, the nerve ran parallel and superficial to the artery.

„ 3, the nerve ran parallel and external to the artery.

34. The *external cutaneous nerve (musculo-cutaneus, or perforans Casserii,)* arises from the plexus by a common trunk with the external root of the median, on the outer side of the axillary artery. After passing for a short distance along the inner border of the coraco-brachialis, it perforates this muscle obliquely outwards, and then descends between the biceps and the brachialis anticus. A little above the elbow-joint, between the outer border of the tendon of the biceps and the supinator radii longus muscle, the nerve perforates the fascia, becomes subcutaneous, and passing under the median cephalic vein, divides into two principal branches, for the supply of the integuments of the forearm.

The external cutaneous nerve, in the upper part of its course,

sends branches to the coraco-brachialis and the short head of the biceps, and, as it descends between the biceps and brachialis anticus, it supplies several branches to each. It usually sends a communicating branch in the middle of the arm, to the median nerve.

A slender branch of the external cutaneous sometimes runs along the outer side of the brachial artery down to the elbow, and supplies the skin.

A filament has been traced into the foramen on the inner side of the humerus, in company with the nutrient artery of the medulla.

In some instances the external cutaneous nerve descends on the inner side of the coraco-brachialis without perforating the muscle : in these cases it often sends a larger branch than usual to the median nerve.

The trunk of the external cutaneous nerve may come from the median at any point between the axilla and the middle of the arm. In some subjects the nerve is absent,—all its branches are then supplied by the median, which is larger than usual. Such anomalies are easily explained by the fact of the two nerves having always a common origin.

35. The *internal cutaneous nerve* is smaller than the external, and arises from the plexus by a common trunk with the ulnar and internal root of the median, on the inner side of the axillary artery. It descends on the inner side of the brachial artery, but more superficially. About the middle or the lower third of the arm it perforates the fascia, generally in company with the basilic vein, becomes subcutaneous, and divides into two or more principal branches, which run along the ulnar side of the fore-arm to the wrist. In its course down the arm, the internal cutaneous usually gives off one or two slender filaments, which supply the skin covering the biceps muscle.

A filament of the internal cutaneous nerve has been traced in company with a branch of the inferior profunda artery into the articular end of the humerus, immediately above the internal condyle.

In some rare instances, the internal cutaneous, at its origin, is situated on the outer side of the axillary artery; in such cases, it crosses over the brachial artery near the middle of the arm.

. 36. The *ulnar nerve*, one of considerable size, arises from the axillary plexus, in common with the internal cutaneous, and the inner root of the median. It descends along the inner side of the brachial artery, as far as the insertion of the coraco-brachialis. The nerve then diverges from the artery, perforates the internal intermuscular septum, and runs, in company with the inferior profunda artery, to the space between the internal condyle and the olecranon.

Between the internal condyle and the olecranon, the ulnar nerve lies upon the internal lateral ligament of the elbow-joint, from which it is sometimes separated by a *bursa* of small size. In two instances a communication has been seen between the bursa and the synovial capsule of the elbow-joint.

The ulnar nerve rarely gives any branches to the upper arm. In a few instances one or two slender filaments have been traced into the triceps muscle.

37. The *lesser internal cutaneous nerve (nerve of Wrisberg)*, the smallest branch of the brachial plexus, assists the larger internal cutaneous in supplying the skin on the inner and posterior surface of the upper arm. It arises in connexion with the internal cutaneous nerve, receives a communication in the axilla from the intercosto-humeral, passes along the inner side of the brachial artery, perforates the fascia near the middle of the arm, and supplies the integuments over the internal condyle and the olecranon.

Previously to the examination of the musculo-spiral nerve it is well to have some knowledge of the great muscle which occupies nearly the whole of the posterior part of the humerus—viz. the *triceps*: to facilitate its dissection the fore-arm should be bent, and the strong fascia removed from the surface of the muscle.

38. The *triceps extensor cubiti* has three distinct origins or heads, named from their position the *external*, *internal*, and *middle* or *long* head. They are united to each other by loose cellular tissue, and may readily be seen on the inner side of the arm. The *middle* or *long* head will be found by dissecting below the head of the humerus immediately above the tendon of the latissimus dorsi; it arises by a strong flat tendon from the inferior border of the scapula, close to the glenoid cavity.

The *external* head will be found behind the insertion of the deltoid ; its origin commences on the posterior part of the humerus, immediately below the great tuberosity, and extends down to the middle of the bone. The *internal* head arises from the posterior part of the humerus below the insertion of the teres major, and near that of the coraco-brachialis. The three heads of the muscle unite near the middle of the arm to form a single fleshy mass, which covers the posterior part of the elbow-joint, and is inserted by a thick tendon into the summit and sides of the olecranon. A more particular account of this muscle will be given hereafter.

39. The *musculo-spiral* or *radial*, the largest of the brachial nerves, arises, in common with the circumflex, from the posterior part of the axillary plexus. It descends behind the axillary artery over the tendon of the latissimus dorsi and the long head of the triceps, the latter of which it separates from the brachial artery. Near the middle of the arm the nerve winds obliquely round the posterior part of the humerus, between the external and internal heads of the triceps, in company with the superior profunda branch of the brachial artery. About the lower third of the outer side of the arm, the nerve will be found deeply embedded between the brachialis anticus and the supinator radii longus muscles. A little above the elbow-joint it divides into its two principal branches,—the *radial*, which accompanies the radial artery along the forearm,—and the *posterior muscular* (posterior interosseous of authors), which perforates the supinator brevis muscle on the outer side of the radius, and supplies the muscles on the back of the forearm.

The *musculo-spiral nerve gives off the following branches* :—

- a.* A small internal cutaneous branch, which perforates the fascia near the middle of the inner side of the arm, and assists in supplying the integuments over the lower part of the triceps : this nerve is occasionally absent.
- b.* One or two branches (each accompanied by an artery from the superior profunda) to each of the three divisions of the triceps muscle.
- c.* An external cutaneous branch, already dissected, which makes its way to the outer side of the arm, between the external head of the triceps and the upper part of the supinator longus. About the middle

of the arm it perforates the fascia, and divides into filaments some of which will be traced down the back of the forearm to the wrist.

d. Before its division the musculo-spiral nerve sends branches to the supinator longus, the extensor carpi radialis longior, and, in some few instances, to the brachialis anticus muscles.

A filament of the musculo-spiral nerve has been traced into one of the foramina in the humerus near the external condyle.

40. *The branches of the brachial artery should now be examined:* there are only three of importance, and all arise from its inner side; they are called the profunda superior, the profunda inferior, and the anastomotica magna.

The *profunda superior* arises from the inner and posterior part of the brachial artery, immediately below the tendon of the teres major muscle. It winds obliquely round the posterior part of the humerus, between the outer and inner heads of the triceps, in company with the musculo-spiral nerve, and a little above the middle of the arm divides into two branches, which run for some distance on either side of the nerve. One of these descends in the substance of the triceps to the olecranon, supplies the muscle and the elbow-joint, and anastomoses with the ulnar and interosseous recurrent arteries. The other branch accompanies the musculo-spiral nerve to the outer side of the arm, descends deep in the fissure between the brachialis anticus and supinator radii longus, and terminates in numerous ramifications, some of which pass in front of the external condyle, and others behind it, to inosculate with the radial and interosseous recurrent arteries.

Previously to its division the superior profunda sends off several branches to the coraco-brachialis and triceps muscles, some of which inosculate minutely with the circumflex and acromial thoracic arteries. These would assist in establishing a collateral circulation if the brachial artery were tied above the origin of its profunda branch.

41. The *profunda inferior* artery arises from the brachial, opposite to the insertion of the coraco-brachialis, or sometimes by a common trunk with the superior profunda. It pierces the intermuscular septum, in company with the ulnar nerve, and descends along the inner border of the triceps to the space between the internal condyle

and the olecranon, where it freely inosculates with the posterior ulnar recurrent artery.

The inferior profunda gives branches to the triceps and brachialis anticus muscles, some of which inoscultate with the anastomotica magna.

The *medullary artery* of the humerus usually arises from the profunda inferior. It pierces the tendon of the coraco-brachialis, enters the nutritious foramen of the bone, and in the medullary canal divides into ascending and descending branches, which anastomose with the other nutrient vessels of the bone derived from the periosteum.

42. The *anastomotica magna artery* arises from the inner side of the brachial, about one or two inches above the elbow, runs tortuously inwards across the brachialis anticus muscle, and divides into branches, some of which pass in front of, and others behind the internal condyle, anastomosing with the inferior profunda and the anterior ulnar recurrent arteries.

Numerous unnamed *muscular branches* arise from the outer side of the brachial artery; one of these, more constant than the rest, supplies the biceps; another runs transversely beneath the coraco-brachialis and biceps, over the insertion of the deltoid, supplying this muscle and the brachialis anticus.

43. The two veins (*venæ comites*) which accompany the brachial artery are continuations of the deep radial and ulnar veins. The internal is usually the larger, since it generally receives the veins corresponding to the principal branches of the artery. In their course they are connected at intervals by transverse branches either in front of, or behind the artery. Near the subscapularis muscle the *vena comes externa* generally crosses obliquely over the front of the axillary artery to join the *v. c. interna*, which then takes the name of the axillary vein.

DISSECTION OF THE FRONT OF THE FORE-ARM.

44. Having prolonged the incision down to the wrist, reflect the skin from the front and sides of the fore-arm, and examine the subcutaneous nerves and veins.

On the radial side of the fore-arm will be found the superficial radial veins, with filaments of the external cutaneous nerve.

On the ulnar side are the superficial ulnar veins, accompanied by filaments of the internal cutaneous nerve.

The external cutaneous branch of the musculo-spiral nerve along the outer and back part of the fore-arm.

About the lower third of the radial border of the forearm, the radial nerve becomes superficial, and turns over the radius to supply the back of the hand and fingers.

Near the styloid process of the ulna, the superficial branch of the ulnar nerve perforates the fascia to reach the back of the hand.

45. The largest veins of the hand are placed on its dorsal surface, in order to be out of the way of pressure. Commencing at the extremity, and running on either side of the fingers, the veins unite on the back of the hand to form a plexus in the shape of an arch, with its concavity upwards, from which the veins of the fore-arm arise.

From the external side of the arch, near the metacarpal bone of the thumb, several branches unite to form the superficial *radial* veins, which run along the outer and front part of the fore-arm to the bend of the elbow, receiving numerous smaller veins in their course.

From the internal side of the arch, near the metacarpal bone of the little finger, commences the root of the superficial *ulnar* veins, which proceed along the inner and front side of the fore-arm to the elbow.

Along the middle of the fore-arm lies the median vein, which is formed by the superficial veins in front of the wrist, and terminates at the elbow by joining the cephalic and the basilic veins.

Such is the most frequent arrangement of the veins, but they are subject to great variety, and they always communicate by large branches with each other. For the disposition of the superficial veins at the elbow, see § 26.

46. Examine the *superficial nerves* of the fore-arm.

a. The *external cutaneous nerve* perforates the fascia between the outer edge of the tendon of the biceps and the supinator radii longus muscle. It passes sometimes above, but most frequently below, the median cephalic vein, sending generally a slender fila-

ment in front of it, and divides into two principal branches, which supply the integuments on the radial border of the fore-arm.

The filaments of this nerve may be traced, in company with the superficial radial veins, down to the wrist. It should be observed, that a branch of the nerve lies for some distance superficial to the radial artery in the lower third of the fore-arm: this branch perforates the fascia near the wrist, accompanies the artery beneath the extensor tendons of the thumb, and is finally distributed to the carpal joint.

Near the wrist, the external cutaneous generally communicates with the radial nerve, and sometimes it sends a filament into the palm of the hand and another over the ball of the thumb.

b. The *external cutaneous branch of the musculo-spiral nerve* divides into filaments, which run along the outer and back part of the fore-arm as low as the wrist, communicating with filaments of the external cutaneous nerve.

c. The *internal cutaneous nerve* divides near the bend of the elbow into an *anterior* and a *posterior* branch, both of which descend along the ulnar border of the fore-arm to the wrist, in company with the superficial ulnar veins. The *anterior* branch, the larger of the two, passes sometimes in front of, but more frequently behind the median basilic vein, and then gives off numerous cutaneous filaments as far as the wrist, some of which join with a cutaneous branch of the ulnar nerve. The *posterior* branch runs over the internal condyle of the humerus, towards the back of the fore-arm, as low as the wrist. This branch sometimes sends a recurrent filament between the internal condyle and the olecranon, to join with the lesser internal cutaneous.

47. Remove the subcutaneous tissue, in order to see the fascia which envelopes the muscles of the fore-arm. It is much stronger than that of the upper arm, more dense and compact on the posterior than on the anterior surface of the fore-arm, and its strength on both surfaces increases as it approaches the wrist, in order that the numerous tendons in this situation may be more effectually maintained in their proper position.

The fascia is attached to the two condyles of the humerus, and

is strengthened by aponeurotic fibres, from the tendons of the biceps on the inner, and the brachialis anticus on the outer side.

The aponeurotic expansion derived from the inner edge of the tendon of the biceps is exceedingly strong, and of a semilunar form. It passes obliquely downwards and inwards, bracing the muscles on the inner side of the arm, and interlacing at right angles with the fibres of the fascia attached to the internal condyle. The relation which it bears to the brachial artery has been alluded to, § 29.

Along the fore-arm the fascia is attached to the ridge on the posterior part of the ulna. At the back of the wrist it is firmly connected with the ridges on the lower end of the radius, and forms the posterior annular ligament. On the front of the wrist it is continued into the anterior annular ligament.

The under surface of the fascia gives origin to the muscular fibres in the upper part of the fore-arm, and sends off a number of septa, which separate the muscles and form so many distinct sheaths, of which the presence is indicated by whitish lines on the surface.

The fascia presents numerous foramina for the passage of vessels and nerves. Over the fossa, at the bend of the elbow, it is very thin and almost deficient, so as to admit of a free communication between the subcutaneous and deep cellular tissue of the fore-arm.

48. Make a vertical incision through the fascia, and remove it from the muscles, only as far as this can be done without injury to the muscular fibres which arise from its under surface.

The muscles of the fore-arm are arranged in two groups: the *pronators* and *flexors* attached to the internal condyle, the *supinators* and *extensors* to the external. They form two sides of a triangular space in front of the elbow, bounded by the pronator teres on the ulnar, and the supinator longus on the radial side. This space contains the brachial artery and its two veins, with the tendon of the biceps on its outer, and the median nerve on its inner side.

The nerve does not always lie close to the artery; it may be distant, as much as half an inch from it. Sometimes the nerve lies immediately superficial to the artery, and very rarely to its outer side. Deep in the groove between the brachialis anticus and

the extensor carpi radialis longior muscles, will be found a branch of the superior profunda artery, and the musculo-spiral nerve.

One or two absorbent glands are sometimes found in the triangular space at the elbow, close to the division of the brachial artery.

Examine the muscles which are attached in succession by a common tendon to the internal condyle of the humerus: namely, the pronator radii teres, the flexor carpi radialis, the palmaris longus, the flexor sublimis digitorum, and the flexor carpi ulnaris.

49. The *pronator radii teres* muscle forms the inner side of the triangular space at the elbow. It arises fleshy from the lower part of the internal intermuscular septum, from the anterior surface of the internal condyle, and from the septum between it and the flexor carpi radialis on its outer side. It has also another origin, partly fleshy and partly tendinous, from the coronoid process of the ulna on the inner side of the insertion of the brachialis anticus. To have a good view of this second attachment, it is necessary to reflect that portion of the muscle which comes from the condyle.

From these two origins, which are separated by the median nerve, the fleshy fibres proceed obliquely downwards and outwards, and terminate in a strong, flat, tendon, which is inserted into a rough surface on the outer and back part of the radius about its middle.

The tendon of insertion into the radius is about one inch and a half in breadth, and receives fleshy fibres on its lower surface, and sometimes on its upper, close to the bone. It is covered by the supinator longus and extensor carpi radialis longior. The action of this muscle is simply to pronate the fore-arm.

50. The *flexor carpi radialis* muscle arises by a thin tendon from the internal condyle, between the pronator teres and the flexor sublimis digitorum; also from the intermuscular septa and the fascia. The fleshy fibres terminate in a flat tendon, which commences about the middle of the fore-arm, and descends towards its radial side. The tendon disappears at the wrist beneath the anterior annular ligament, passes through a groove in the os trapezium, lined by a synovial membrane, and is inserted by a broad expansion into the base of the second metacarpal bone, and some-

times also into the third. The tendon lies deep in the palm, and will be seen with the dissection of that part. This muscle bends the hand, and also assists in pronating it. The outer border of its tendon is the guide to the radial artery in the lower half of the fore-arm.

51. The *palmaris longus* muscle is situated on the inner side of the flexor carpi radialis. It arises from the common tendon attached to the internal condyle, and from the intermuscular septa. This slender muscle, contained in a groove between the flexor carpi radialis and the flexor sublimis digitorum, terminates about the middle of the forearm in a flat tendon, which descends vertically down the middle of the forearm to the wrist, where it passes over the annular ligament, and is continued into the palmar fascia. This muscle is a tensor of the fascia in the palm, and may also assist in bending the hand.

The palmaris longus is sometimes absent. The situation of its muscular portion is subject to variety ; sometimes occupying the middle, and sometimes the lower third of the fore-arm. The tendon is in some instances wholly inserted into the anterior annular ligament. A small *bursa* is in some cases found between the tendon and the ligament.

52. The *flexor sublimis digitorum perforatus*, situated partly beneath and on the inner side of the preceding, is a muscle of considerable size. It has two distinct origins. The longer and more internal origin takes place from the lower border of the internal condyle, from the internal lateral ligament of the elbow joint, from the inner side of the coronoid process of the ulna, and from the intermuscular septa. The shorter origin, separated from the preceding by the median nerve, takes place by tendinous and fleshy fibres from an oblique ridge, which commences on the front surface of the radius near the tuberosity, and terminates near the middle of the outer border of the bone. This, which is called its *radial origin*, is partly concealed by the insertion of the pronator teres. A broad thick muscle is thus formed, which passes down the middle of the fore-arm, and divides into four distinct muscular slips : from these, four tendons arise, which pass beneath the annular liga-

ment into the palm, and so on to the fingers, where they split to allow the passage of the deep flexor tendons, and are inserted into the base of the second phalanges. Its action is, therefore, to bend the second joint of the fingers, and afterwards the first.

In some instances there are only three tendons at the wrist; in such cases the tendon of the ring-finger gives off in the palm that of the little finger.

The four tendons at the wrist are not all situated on the same plane. Those of the middle and ring-fingers lie immediately above those of the fore and little fingers.

All the tendons, excepting sometimes that of the ring-finger, receive fleshy fibres on their outer borders as low as the annular ligament.

53. The *flexor carpi ulnaris* muscle is situated on the inner side of the flexor sublimis digitorum. It arises from the lower part of the internal condyle, and from the inner edge of the olecranon, these two origins forming a kind of arch, under which the ulnar nerve passes. It is also attached to the upper two-thirds of the posterior edge of the ulna, through the medium of the aponeurosis of the fore-arm. To obtain a good view of this aponeurosis, the muscle must be separated from the flexor profundus digitorum, which lies beneath it.

The tendon makes its appearance on the radial side of the muscle, about the lower third of the fore-arm, and receives fleshy fibres on its ulnar side as low as the wrist. It is *inserted* into the os pisiforme, and thence by a strong tendon into the base of the fifth metacarpal bone and the os unciforme.

The tendon of the *flexor carpi ulnaris* is the guide to the ulnar artery, which lies close to its radial border, and is in some instances partially overlapped by it. As it passes over the annular ligament, the tendon gives off externally a fibrous expansion to protect the ulnar vessels. A small *bursa* is sometimes found beneath its tendon just before its insertion into the os pisiforme. The *action* of this muscle is to bend the hand and incline it to the ulnar side.

54. The *supinator radii longus* muscle is situated on the outer side of the fore-arm, and forms the external boundary of the triangular space at the bend of the elbow. It arises from the outer side of

the humerus, commencing a little below the insertion of the deltoid; and extending down two-thirds of the ridge leading to the outer condyle; also from the intermuscular septum, which separates it from the triceps. The muscular fibres descend, and terminate about the middle of the fore-arm in a flat tendon, which gradually becomes narrower, and is inserted into the base of the styloid process of the radius. The inner border of the muscle is a guide to the radial artery. It supinates the hand, and also acts as a flexor of the fore-arm.

The examination of the deeper-seated muscles should be postponed till we have traced the vessels and nerves of the fore-arm.

55. The brachial artery usually divides opposite the coronoid process of the ulna into the radial and ulnar arteries.

The *radial artery* passes down the radial side of the fore-arm to the wrist, where it turns over the external lateral ligament of the carpus, beneath the extensor tendons of the thumb, appears for a short distance upon the back of the hand, and sinks into the space between the first and second metacarpal bones to form the deep palmar arch. Thus, a line drawn from the middle of the bend of the elbow to the metacarpal bone of the thumb, would nearly indicate its course. In the upper third of the fore-arm, the artery is situated between the pronator teres on the inner, and the supinator longus muscle on the outer side; the fleshy border of the latter overlaps it in muscular subjects. In the lower two-thirds of the fore-arm the artery is more superficial, and is placed between the tendons of the supinator longus on the outer, and the flexor carpi radialis on the inner side. In its course, it lies successively on the following muscles and tendons: first, upon the tendon of the biceps; secondly, upon the supinator radii brevis, separated from it by more or less fat and cellular membrane; thirdly, upon the tendon of the pronator teres; fourthly, upon the radial origin of the flexor sublimis; fifthly, upon the flexor longus pollicis; and, lastly, upon the pronator quadratus, and the extremity of the radius. The artery is accompanied by two veins, which communicate at frequent intervals by transverse branches, and join the venæ comites of the brachial artery at the bend of the elbow.

In the middle third of its course the artery is accompanied by

the radial nerve, (a branch of the musculo-spiral) which lies to its outer side. Below this point, the nerve leaves the artery, and passes under the tendon of the supinator longus to the back of the hand: in some instances, however, the nerve sends a filament with the artery as low as the wrist.

Thus, in the situation where the pulse is usually felt, the radial nerve no longer accompanies the artery, but here the vessel is accompanied by a branch of the external cutaneous nerve, which runs superficial to it; some of its filaments perforate the fascia, twine round the artery, and accompany it to the back of the hand.

Near the wrist the artery is covered by a strong layer of fascia, and is placed about one-third of an inch from the outer edge of the tendon of the flexor carpi radialis.

56. The following are the branches of the radial artery in the forearm:—

The *radial recurrent* artery is given off just below the elbow; it makes a slight curve downwards, and then runs upwards and outwards in front of the external condyle of the humerus, between the extensor carpi radialis longior and the brachialis anticus muscles, and terminates in a direct anastomosis with the superior profunda, a branch of the brachial. The radial recurrent sends numerous branches, which ascend and descend to the muscles in the neighbourhood, and is one of the chief arteries which supply the elbow-joint, anastomosing freely with the other articular arteries.

Numerous unnamed *muscular* branches are given off by the radial in its course.

57. The *arteria superficialis volæ* generally arises from the radial, about half an inch, or more, above the lower end of the radius; it runs superficially over the anterior annular ligament of the carpus, above or perhaps through the origin of the muscles of the ball of the thumb, into the palm of the hand, where it inosculates with the superficial branch of the ulnar, thus completing the superficial palmar arch.

There is great variety in the size and origin of the *superficialis volæ*; sometimes it is very large, arises higher than usual, and runs to the wrist parallel with the radial; sometimes it is very small, terminating in the muscles of the thumb; or it may be absent.

58. The *anterior* and *posterior carpal* arteries are small branches of the radial, which run beneath the tendons, and supply the synovial membrane and bones of the carpus, anastomosing with the branches of the interosseous arteries and carpal branches of the ulna. The remaining branches of the radial will be described with the palm.

59. The *radial nerve*, a branch of the musculo-spiral, is given off above the bend of the elbow, deep between the extensor carpi radialis longior and brachialis anticus muscles; it descends along the fore-arm, on the outer side of the radial artery, in close contact with the inner edge of the extensor carpi radialis longior, and covered by the supinator radii longus. In the upper third of the fore-arm the nerve is at some distance from the artery; in the middle third it approaches much nearer to it; but in the lower third, the nerve, leaving the artery, passes obliquely underneath the tendon of the supinator longus, perforates the fascia on the outer side of the fore-arm, and generally divides into two branches, an *external* and an *internal*, which supply the skin on the back of the hand, thumb, and two next fingers.

a. The *external* branch, the smaller of the two, passes along the outer border of the supinator longus, and extends to the radial side of the thumb; it sends a branch to the external cutaneous nerve and the palmar filament of the median.

b. The *internal* division of the nerve passes over the extensor tendons of the thumb to the back of the hand, where it gives off the dorsal digital nerves. One ramifies on the ulnar side of the thumb, the second on the radial side of the index finger, the third divides so as to supply the opposite sides of the index and middle fingers, and is connected on the back of the hand with a branch of the ulnar nerve.

60. Examine the *course and relations of the ulnar artery*.

This artery, larger than the radial, arises from the brachial at the middle of the elbow, runs obliquely downwards and inwards along the ulnar side of the fore-arm to the wrist, where it passes over the anterior annular ligament near the pisiform bone, and entering the palm, forms the superficial palmar arch, by anastomosing with the superficialis volæ, or some other branch of the radial.

In the upper half of its course the artery inclines obliquely inwards, describing a gentle curve with the concavity towards the radius, and situated deep beneath the superficial layer of muscles—the pronator teres, flexor carpi radialis, palmaris longus, and flexor sublimis digitorum. In the lower part of its course it descends longitudinally between the flexor sublimis digitorum and flexor carpi ulnaris, and is only covered by the general aponeurosis of the forearm and a strong layer of fascia, which passes from the tendon of the flexor carpi ulnaris to the flexor profundus digitorum. At its commencement the ulnar artery rests for a short distance on the insertion of the brachialis anticus muscle; in the remainder of its course it lies on the flexor profundus digitorum.

The ulnar nerve, passing behind the internal condyle, is at first separated from the artery by a considerable interval: about the middle third of the forearm it joins the artery, and accompanies it in the rest of its course, lying close to its inner side. Both pass over the anterior annular ligament of the carpus, lying close to the pisiform bone,—the nerve being nearer to the bone, and the artery more superficial. A strong aponeurotic expansion from the tendon of the flexor carpi ulnaris protects them in this exposed situation.

As the artery lies on the brachialis anticus muscle it is crossed superficially by the median nerve,—the second head of the pronator teres intervening. In some instances this second head passes beneath the artery.

Observation should be particularly directed to the depth of the ulnar artery from the surface, and the many muscles which cover it in the upper third of its course. In the middle third of the fore-arm it is partially overlapped by the flexor carpi ulnaris. In the lower third it lies close to the radial border of the flexor carpi ulnaris, which is the proper guide to the vessel.

61. The following are the principal branches of the ulnar artery in the forearm:

The *anterior* and *posterior ulnar recurrent* arteries arise immediately below the elbow-joint,—sometimes by a common trunk, sometimes separately.

The *anterior*, the smaller of the two, passes upwards in front of

the brachialis anticus, beneath the pronator teres, and inosculates with the inferior profunda and anastomotica magna arteries.

The *posterior* ulnar recurrent ascends beneath the flexor sublimis digitorum, to the space between the internal condyle and the olecranon, where it passes between the two heads of the flexor carpi ulnaris in company with the ulnar nerve. The artery lies close to the internal lateral ligament, through which many small branches pass, to supply the synovial membrane of the elbow-joint. This artery, like the former, supplies the surrounding muscles, and communicates freely with the anastomotica magna and inferior profunda, and the other articular arteries. Both the ulnar recurrent arteries send off descending branches, which supply the muscles on the inner side of the fore-arm.

The next branch of the ulnar is the *common interosseous* artery, which arises about an inch and a half below the division of the brachial, near the point where the ulnar artery is crossed by the second head of the pronator teres. The further examination of the interosseous artery must be for the present postponed. (See § 67.).

Numerous *muscular* branches arise from the ulnar artery in its course down the fore-arm.

A branch (*arteria comes nervi mediani*) almost always accompanies the median nerve. It lies in close contact with the nerve, and sometimes in its very centre : though usually of small size, it may be as large as the ulnar artery itself ; and in such a case it passes under the annular ligament with the nerve, to join the arterial arch in the palm.

Immediately above the styloid process of the ulna, the ulnar artery sends off *anterior* and *posterior carpal* branches, similar in their course and distribution to the corresponding branches from the radial, with which they freely communicate, supplying the synovial membrane and bones of the carpus.

A little below the pisiform bone the ulnar artery divides into a deep and superficial palmar branch, which will be described with the anatomy of the palm of the hand.

62. The *ulnar nerve* descends behind the internal condyle between the two origins of the flexor carpi ulnaris. In its course down the upper part of the fore-arm, the nerve is still covered by

this muscle, and lies upon the flexor profundus digitorum. About the middle third of the fore-arm, the nerve joins the ulnar artery, and runs along its inner side over the annular ligament into the palm. In the lower part of the forearm, the nerve is not quite so superficial as the artery, being more or less overlapped by the tendon of the flexor carpi ulnaris.

Behind the internal condyle a slender filament from the ulnar nerve may sometimes be traced through the internal lateral ligament into the elbow-joint.

One or two branches enter the upper part of the flexor carpi ulnaris, and another, given off a little lower down, supplies the inner half of the flexor profundus digitorum ; the outer half being supplied by the median nerve.

Near the middle of the fore-arm, a slender cutaneous branch sometimes comes from the ulnar nerve, and divides into two filaments, one of which perforates the fascia, and joins a filament of the internal cutaneous, the other accompanies the ulnar artery, and supplies the skin of the palm.

a. About one inch and a half above the styloid process of the ulna the nerve gives off a large cutaneous branch to the back of the hand. It crosses obliquely under the tendon of the flexor carpi ulnaris, and, immediately below the styloid process of the ulna, appears on the back of the hand, where it divides into two branches,—of which the one runs on the inner side of the little finger, the other subdivides, to supply the outer side of the little finger, both sides of the ring, and generally half the middle finger. This branch communicates with a filament from the dorsal branch of the radial nerve.

63. Examine the *median nerve*. It will be found in the triangular space at the bend of the elbow on the inner side of the brachial artery. It passes between the two origins of the pronator teres, and descends along the middle of the fore-arm, lying between the flexor sublimis and the flexor profundus digitorum : the nerve then enters the palm beneath the anterior annular ligament of the carpus, and terminates by dividing into five branches for the supply of the thumb, both sides of the fore and middle fingers, and the outer side of the ring finger.

In the upper three-fourths of the fore-arm the median nerve lies deep between the muscles ; but in the lower fourth it is more superficial, and runs very nearly down the centre of the wrist. Its exact position is between the fleshy border of the outer tendon of the flexor sublimis and the inner border of the tendon of the flexor carpi radialis, from which in an arm of ordinary size the nerve is about a quarter of an inch distant.

If the tendon of the palmaris longus happen to be broader than usual, it may partially cover the median nerve near the wrist : but most frequently the nerve is immediately beneath the fascia,—the tendon lying to its ulnar side.

Immediately below the elbow, the median nerve sends off branches to supply the pronator and all the flexor muscles of the fore-arm, with the exception of the flexor carpi ulnaris and the inner half of the flexor profundus, which are supplied by the ulnar nerve. The branch to the pronator teres and the radial flexor is sometimes given off above the elbow, and one of these muscular nerves sometimes sends a filament which penetrates the front of the elbow joint. The interosseous branch of the median will be described with the corresponding artery. (See § 68.)

Before the median nerve passes beneath the annular ligament of the wrist it sends off its superficial palmar branch. This branch lies close to the radial side of the median nerve, perforates the fascia at the wrist, and, passing over the anterior annular ligament, divides into small filaments, which communicate with a corresponding branch from the radial nerve, and supply the skin of the palm and ball of the thumb.

Divide the superficial layer of muscles across the centre of the forearm, and reflect them, in order to obtain a full view of those more deeply seated. Observe the intervening fascia. The principal vessels and nerves should be preserved.

The deep-seated muscles consist of the flexor digitorum profundus, and the flexor longus pollicis ; beneath both, in the lower fourth of the fore-arm, lies the pronator quadratus. On the interosseous membrane will be seen the anterior interosseous artery and nerve.

64. The *flexor profundus digitorum* is the largest and thickest

muscle of the forearm. It arises from the upper two-thirds of the anterior surface of the ulna, and from the same extent of its internal surface up to the olecranon, so that its origin embraces the insertion of the brachialis anticus; it arises also from the aponeurosis which is attached to the posterior edge of the ulna, from the inner two-thirds of the interosseous ligament, and sometimes by a few fibres from the inner edge of the radius.

The muscle, covered on its inner side by the aponeurosis connected with the flexor carpi ulnaris, divides about the middle of the fore-arm into three or four muscular slips, which terminate in as many broad, flat, tendons. These tendons lie upon the same plane, and pass beneath the annular ligament under those of the superficial flexor, into the palm. On the first phalanx of the fingers, the tendons of the deep flexor perforate those of the superficial, and are inserted into the base of the third or ungual phalanx of the fingers.

The tendons receive muscular fibres on their under surface quite down to the wrist. Those of the ring and little fingers are generally connected with each other, but that of the index finger is almost always distinct from the rest, and therefore capable of independent action.

The flexor profundus bends the last joint of the fingers.

65. The *flexor longus pollicis* is situated on the front surface of the radius, on the same plane with the last muscle. It arises by delicate fleshy fibres from the front surface of the radius, comprising the space between the tubercle and the pronator quadratus, also from the interosseous membrane, and often by a slip from the coronoid process of the ulna. Its flat tendon makes its appearance high up in the muscle, receives fleshy fibres on its under and outer surface as low as the wrist, and proceeds beneath the annular ligament to the last phalanx of the thumb.

66. The square muscle at the lower end of the radius and ulna is called the *pronator quadratus*, and may be exposed by separating the tendons of the muscles last described, which pass over it; it arises from the internal border and the anterior surface of the lower fourth of the ulna; its fibres pass nearly transversely outwards, and are inserted into the anterior surface of the lower fourth of the ra-

dius; the muscle is thicker than it appears, and its superficial fibres are much longer than those which pass between the mesial border of the bones. It rotates the radius on the ulna.

67. Nearly on a level with the insertion of the biceps, the ulnar artery gives off from its outer side the *common interosseous* trunk, a large branch, about half an inch or more in length, which passes backwards and divides into two,—the *anterior*, and *posterior interosseous* arteries.

The *anterior interosseous* artery descends along the interosseous membrane, nearer to the radius than the ulna, lying between the flexor profundus digitorum and the flexor longus pollicis. At the upper edge of the pronator quadratus it divides into two branches; one of which, the smaller of the two, supplies the muscle and descends in front of the carpal bones, communicating with the anterior carpal arteries from the radial and ulnar, and the deep palmar arch; the other perforates the interosseous membrane, and divides into branches which inosculate with the posterior carpal and posterior interosseous arteries.

The anterior interosseous artery gives off branches to the muscles on either side, and the nutritious arteries which perforate the anterior surface of the radius and ulna from below upwards, near the centre of the forearm, to supply the medullary membrane. Several small branches pierce the interosseous membrane, and are distributed to the muscles on the back of the forearm.

68. The anterior interosseous nerve is a branch of the median; it lies close to the outer side of the artery, sends filaments to the flexor longus pollicis and flexor profundus digitorum, and is lost in the under surface of the pronator quadratus.

The interosseous artery is sometimes confined to the interosseous membrane by a layer of fibrous tissue; hence the occasional difficulty in placing a ligature round it after amputation.

DISSECTION OF THE PALM OF THE HAND.

69. A longitudinal incision should be made through the skin down the centre of the palm to the cleft between the middle and ring fingers:

in reflecting the skin, observe the peculiar structure of the subcutaneous tissue.

Over the ball of the little finger and the distal ends of the metacarpal bones, the subcutaneous structure is composed of a very dense filamentous cellular tissue, which contains numerous pellets of fat, forming a kind of elastic cushion. This structure is prolonged down the fingers to their extremities: it is less developed over the ball of the thumb and in the palm of the hand, where the skin is closely connected to the subjacent palmar fascia.

Numerous openings will be observed in the fascia for the transmission of cutaneous vessels and nerves, which come from the superficial palmar arch.

Be careful not to remove a small cutaneous muscle, the *palmaris brevis*, which is situated at the upper and inner part of the palm.

70. In the dense cellular tissue over the anterior annular ligament of the carpus, will be found the *superficial palmar branch of the median nerve*; it is derived from the median above the annular ligament, over which it passes into the palm of the hand, and subdivides into numerous cutaneous filaments: it is often joined by small branches from the radial and external cutaneous nerves.

71. Examine the *palmar fascia*. This membrane has a silvery lustre, and, in the centre of the palm, is remarkably dense and strong; it is divided into three portions, a central,—by far the most conspicuous; an external, covering the muscles of the thumb; and an internal, covering the muscles of the little finger. From the deep surface of the fascia two fibrous septa dip down, so as to divide the palm into three separate compartments; one for the ball of the thumb, a second for that of the little finger, and a third for the centre of the palm.

The fascia is formed in great part by an expansion of the tendon of the *palmaris longus*, but is also materially strengthened by fibres from the anterior annular ligament. In cases, therefore, where the *palmaris longus* is absent, the palmar fascia is not necessarily deficient.

The central portion of the fascia is triangular in form with the

apex at the wrist. About the middle of the palm it splits into four portions, which are connected together by strong transverse tendinous fibres, extending completely across the palm, and corresponding pretty nearly to the transverse furrow of the skin in this situation.

Each of these four divisions of the fascia splits into two portions, which embrace the corresponding flexor tendons, and are intimately connected with the fibro-cartilaginous ligament of the first joint of the fingers. In this way, the flexor tendons of each finger are surrounded and kept in place in the lower part of the palm, by a kind of fibrous ring formed by the palmar fascia. In order to see this distinctly, the fascia should be divided longitudinally over one of the tendons. The manner in which it embraces the tendons, as well as its deep connexion with the transverse metacarpal ligament of the fingers, will be readily recognized. Between the four primary divisions of the palmar fascia the digital vessels and nerves will be observed, surrounded by fibro-cellular tissue and fat, and descending nearly in a line with the clefts between the fingers.

In the hands of mechanics, in whom the palmar fascia is usually very strong, we commonly find that slips of it are lost in the skin at the lower part of the palm, and also for a short distance along the sides of the fingers.

The chief use of the palmar fascia is to protect the vessels and nerves from pressure when anything is grasped in the hand. It also confines, and binds down the flexor tendons of the fingers in their proper place.

Between the interdigital folds of the skin, are found aponeurotic fibres, constituting what are called the *transverse ligaments of the fingers*. They are connected with the palmar fascia, and with the heads of the first phalanges, and form a continuous ligament across the lower part of the palm, in front of the digital vessels and nerves. Their office is to prevent a too great separation of the fingers.

The *external* and *internal* portions of the palmar fascia, covering respectively the muscles of the ball of the thumb and the little finger, are both continuous with the central portion.

The external portion is connected with the anterior annular ligament, and receives an expansion from the tendon of the extensor ossis metacarpi pollicis. It passes over the muscles forming the ball of the thumb, and is attached to the radial border of the first metacarpal bone. The internal portion, thin and transparent, is chiefly derived from the tendon of the flexor carpi ulnaris ; it covers the muscles of the little finger, and is inserted into the ulnar border of the fifth metacarpal bone.

72. The *palmaris brevis* is a small cutaneous muscle, situated at the upper and inner side of the palm. It consists of several small bundles of muscular fibres, separated by fat and cellular tissue, which arise from the inner edge of the central portion of the palmar fascia, pass transversely inwards, and terminate in the skin on the inner side of the palm. Its use is to increase the concavity of the palm, by drawing the skin towards the centre of the hand.

Divide the tendon of the palmaris longus, and reflect the palmar fascia from the annular ligament towards the fingers ; observe the attachment of its deeper fibres to the lower border of the ligament. Remove the loose cellular tissue which permits the free play of the tendons beneath the fascia, and expose with care the vessels and nerves in the palm.

73. *Superficial palmar arterial arch.*—The ulnar artery passes over the annular ligament of the wrist near the pisiform bone, describes a curve across the upper part of the palm beneath the palmar fascia, and, gradually diminishing in size, inosculates with the superficialis volæ, or some other branch of the radial, so as to form the superficial palmar arch. The curve of the arch is directed towards the ball of the thumb, and crosses over the flexor tendons and the divisions of the median nerve. No precise rule can be given for finding its exact position in the hand : most commonly its greatest convexity descends as low as a horizontal line drawn across the junction of the upper with the middle third of the palm ; but sometimes it descends as low as the centre of the palm.

In its passage over the annular ligament, the artery is protected by the projecting pisiform bone, and by a tendinous expansion which passes from the tendon of the flexor carpi ulnaris to that of the palmaris longus. The ulnar nerve lies close to its inner side,

In the palm, the artery lies for a short distance upon the muscles of the little finger, before it crosses the flexor tendons, and it is covered by the palmaris brevis muscle and the palmar fascia.

74. *Branches of the ulnar artery in the palm.*—Immediately below the pisiform bone, the ulnar artery gives off the *ulnaris profunda*, which sinks deep into the palm between the abductor and flexor brevis minimi digiti, to assist in forming the deep palmar arch (see § 98). It is accompanied by a large branch of the ulnar nerve.

From the concavity of the superficial palmar arch small branches ascend to the carpus, and there inosculate with the other carpal branches of the radial and ulnar arteries.

From the convexity of the arch there commonly arise *four digital arteries*, which supply all the fingers, excepting the radial side of the index finger. The first descends obliquely over the muscles on the inner side of the palm, to the ulnar side of the little finger, along which it runs to the apex. The second, third, and fourth descend nearly vertically between the tendons, in a line with the clefts between the fingers, and about half an inch above the clefts each divides into two branches, which proceed along the opposite sides of the palmar aspect of the fingers nearly as far as the extremity of the last phalanges, where they unite to form an arch with the convexity towards the end of the finger; from this arch numerous branches arise and supply the papillæ of the skin, endowed with the exquisite sense of touch.

In the palm of the hand the digital arteries send small branches to the lumbricales muscles and the sheaths of the flexor tendons, and each is generally joined by a small branch from the corresponding palmar interosseous artery, a branch of the deep palmar arch (see § 98).

The arteries freely communicate, both on the palmar and dorsal aspect of the fingers, by transverse branches, which supply the oint and the sheaths of the tendons. Near the ungual phalanx, a considerable branch passes to the back of the finger, and forms a network of vessels round the root of the nail.

The arteries in the palm are accompanied by small veins, which surround them by their frequent communications.

75. The *ulnar nerve* passes over the annular ligament into the palm, on the inner side of, and rather behind the ulnar artery. It is protected by a process of fascia, and lies in a groove between the pisiform and unciform bones, so that it is perfectly secure from pressure in this apparently exposed situation. A small *bursa* is sometimes found between the nerve and the ligament.

Immediately below the pisiform bone, the ulnar nerve divides into a superficial and a deep palmar branch. The deep branch supplies the muscles of the little finger, and accompanies the ulnaris profunda artery into the palm (see § 99).

The superficial branch divides into two digital nerves, for the supply of both sides of the little finger and the ulnar side of the ring finger. The more internal of these two nerves sends filaments to the palmaris brevis, to the integument on the inner side of the palm, and is joined by a filament from the dorsal cutaneous branch of the ulnar nerve; it then runs along the ulnar side of the palm, internal to its corresponding artery, and is continued along the inner side of the little finger to the extremity. The other nerve descends internal to its corresponding artery, and passes obliquely over the flexor tendons of the little finger towards the cleft between the little and ring fingers, where it subdivides into two branches, which run along the opposite sides of these two fingers to their extremities. It also sends a filament to communicate with the median nerve, behind the superficial palmar arch.

76. *Anterior annular ligament of the carpus.*—This exceedingly strong and thick ligament confines the flexor tendons of the fingers and thumb, and fastens together the bones of the carpus. It is attached externally to the scaphoid and trapezium bones; internally to the pisiform and unciform, and to the ligament connecting them. It is made up of oblique and transverse fibres, interlacing more or less with each other. Its upper border is continuous with the aponeurosis in front of the wrist; its lower border terminates in the palmar fascia; its anterior surface receives the expanded tendon of the palmaris longus, and gives origin to most of the muscles constituting the ball of the thumb and little finger.

Cut vertically through the ligament, and observe, that, with the concavity of the carpal bones, it forms a complete elliptical canal,

with the broad diameter transversely, and somewhat expanded at either end. Its internal surface is lined by a synovial membrane which is reflected loosely over the tendons. The canal transmits the superficial and deep flexor tendons of the fingers, the long flexor tendon of the thumb, and the median nerve. The tendon of the flexor carpi radialis is contained in a distinct sheath, lined by synovial membrane, formed partly by the annular ligament and partly by the groove in the trapezium.

77. *Branches of the median nerve in the palm.*—In its passage under the annular ligament, the median nerve is enveloped in a fold of synovial membrane ; it becomes considerably wider and flatter, and might be mistaken for one of the tendons. It lies between the tendons of the flexor digitorum sublimis and the flexor longus pollicis, and upon those of the flexor profundus ; and it is rather nearer to the radial than the ulnar side of the wrist. As soon as it appears in the palm, the nerve lies superficial to all the tendons, gives a branch to the muscles of the ball of the thumb, and then divides into five branches, two for the thumb, the rest for the fore and middle fingers and the radial side of the ring finger : these three last are crossed by the superficial arterial arch.

The muscular branch is given off immediately below the annular ligament, curves upwards, and divides into filaments which supply the muscles of the ball of the thumb.

The two nerves of the thumb proceed, one on each side of the long flexor tendon, to the last phalanx.

The first digital nerve passes down the outer edge of the first lumbricalis muscle, and runs along the radial side of the index finger.

The second digital nerve crosses the tendon of the index finger, descends vertically towards the cleft between the index and middle fingers, and subdivides into two branches, which supply their opposite sides.

The third crosses obliquely over the tendon of the middle finger, is joined by a filament from one of the ulnar digital nerves, and then subdivides above the cleft between the middle and ring fingers, to supply their opposite sides.

In the palm of the hand, the digital nerves are situated on a

plane beneath the arteries, but most of them communicate with each other by slender filaments which cross in front of the vessels. They send small filaments to supply the first, second, and sometimes the third lumbricalis muscle, and others which pass through the fascia to the skin of the palm.

About an inch and a quarter above the clefts between the fingers, each digital nerve subdivides into two branches, between which the digital artery passes and bifurcates rather lower down; therefore a vertical incision down the cleft would divide the artery before the nerve.

78. In their course along the fingers and thumb, the nerves lie superficial to the arteries, and rather nearer to the flexor tendons. Near the middle of the first phalanx each nerve sends a considerable branch, which runs along the back of the finger nearly to the extremity, communicating with the dorsal branches derived from the radial and ulnar nerves. Near the ungual phalanx another branch is distributed to the skin around and beneath the root of the nail. Small branches of the digital nerves encircle the trunks of the digital arteries, giving filaments to the skin of the finger and the external surface of the sheaths of the tendons; other filaments, accompanied by small arteries, enter the tendons themselves through the slender synovial bands attached to their posterior surface. Each nerve terminates near the end of the finger in a brush of filaments, accompanied by minute arteries, with their points directed to the papillæ of the skin. A communication may sometimes be traced between the two nerves.

79. *Corpuscles of Pacini.*—These are little semitransparent elliptical bodies, which are observed chiefly upon the cutaneous nerves of the hands and feet. Some of them will be readily found by carefully examining the trunk of a nerve, or one of its smaller branches, in the subcutaneous tissue at the root of a finger. Each corpuscle is attached by a slender fibro-cellular pedicle to the nerve upon which it is situated; through the pedicle a single primitive nerve-fibril passes into the corpuscle. The corpuscle itself is composed of a series of concentric capsules, separated by intervals containing fluid; and the nerve-fibril terminates in a central cavity which exists in the axis of the corpuscle.

80. *Flexor tendons and their sheaths.*—Observe the arrangement of the flexor tendons beneath the annular ligament, and trace them to the ends of the fingers. The tendons of the flexor sublimis are arranged in two layers, the one above the other. Those of the flexor profundus lie on the same plane, and are sometimes connected by thin tendinous slips; but the tendon of the index finger is always distinct. Immediately below the annular ligament the tendons separate from each other; those of the superficial flexors are placed in front of the deep flexors, and near the metacarpal joints of the fingers they pass in pairs through strong fibrous sheaths, resulting from the divisions of the palmar fascia (see § 71). Below the metacarpal joint the two tendons for each finger enter the sheath which confines them in their course along the phalanges. It is formed by a strong fibrous membrane, which is attached to the projecting ridges on either side of the first and second phalanges, and thus converts the groove in front of these bones into a complete canal, exactly large enough to contain the tendons. The density of the sheath necessarily varies in particular situations, otherwise there would be an obstacle to the easy flexion of the fingers. To ascertain this, let one of the sheaths be opened along its entire extent; it will then be obvious that it is much stronger over the phalanges, that is, between the joints, than over the joints themselves, where it is always very thin, and is sometimes deficient; through these sheaths, inflammation commencing in the integuments of the finger may readily extend to the synovial membrane of the tendon.

On closer inspection it will be observed that the sheath is composed of bands of fibres, which take different directions, and have therefore received distinct names. The strongest of these are called the *ligamenta vaginalia*. They constitute that part of the sheath which corresponds to the body of the phalanx, and extend transversely from one side of the bone to the other; they are much stronger over the first than the second phalanges. The *ligamenta cruciata* are two cross tendinous slips, situated at the lower part of the first and the second phalanges. They are attached to either side of the upper end of the phalanges, and cross obliquely over the tendons to the opposite border of the body of the bone; one

or other of them is often deficient. The *ligamenta annularia* are situated immediately in front of the joints, and may be considered as thin continuations of the *ligamenta vaginalia*. They consist of delicate fibres, which are attached on either side of the joints to the glenoid ligaments, and pass transversely over the tendons. They are often indistinct.

Open one of the sheaths, and it will be seen that in front of the articulations the tendons glide over a smooth fibro-cartilaginous structure, called the *glenoid* ligament. In some cases, as, for instance, at the last joint of the thumb, this ligament contains a small sesamoid bone.

81. The interior of the sheath, as well as the surface of the tendons, is lined by a delicate synovial membrane, of the extent of which it is important to have a correct knowledge. With a probe, or other blunt instrument, we may easily ascertain that the synovial membrane is reflected from the sheath upon the tendons, a little above the metacarpal joints of the fingers; that is, nearly in a line with the transverse fold in the skin observed in the lower third of the palm. Towards the distal end of the finger, the synovial sheath commonly stops short of the last joint, so that it is not injured in amputation of the ungual phalanx.

82. With regard to the tendons themselves, we observe that the superficial flexor, near the root of the finger, presents on its under surface a slight groove which receives the corresponding deep flexor tendon; about the middle of the first phalanx it splits into two portions, through which the deep flexor passes. The two portions reunite below the deep tendon so as completely to embrace it, and then divide a second time into two slips, which interlace with each other and are inserted into the outer and inner sides of the second phalanx. In some instances, the superficial flexor tendon has an attachment to the sides of the first phalanx, so that, if the finger were amputated at the second joint, the power of bending the first might, to a certain extent, be retained.

The deep flexor tendon, having passed through the opening of the superficial flexor, is attached to the whole breadth of the base of the last phalanx.

By raising the tendons from the sheath, and separating them

from each other, we shall observe what are called the *vincula tendinum*. They consist of folds or bridles of the synovial membrane, which convey minute blood-vessels and nerves to the tendons. They are generally triangular, with their bases attached longitudinally along the middle of the phalanx. The fold from the first phalanx, after supplying the superficial flexor tendon, passes through the bifurcation to the deep flexor. Sometimes additional vincula tendinum proceed to the tendons from the sides of the phalanges.

83. The *tendon of the flexor longus pollicis* lies on the radial side of the other flexor tendons beneath the annular ligament. It passes outwards between the two portions of the flexor brevis pollicis and the two sesamoid bones of the thumb, enters its proper fibrous sheath, and is inserted by a broad expansion into the base of the last phalanx.

The tendon is provided with a synovial sheath, which is prolonged from the large bursa of the flexor tendons beneath the annular ligament, and accompanies it down to the last joint of the thumb; consequently the sheath is injured in amputation of the last phalanx.

84. A large and loose synovial sac, called the *bursa of the carpus*, is placed beneath the anterior annular ligament of the wrist, for the purpose of facilitating the play of the tendons through the carpal groove. It lines the under surface of the ligament and the groove formed by the carpal bones, and is thence reflected in loose folds over the tendons, separating them more or less from each other. Above the upper edge of the ligament it is prolonged over both surfaces of the tendons to the extent of an inch, or sometimes two inches, and the cul-de-sac thus formed reaches higher on their deep than on their superficial surface. Below the ligament the bursa extends for a short distance into the palm, and sends off prolongations for each of the flexor tendons, which accompany them nearly down to the middle of the hand. Thus it will be easily understood, that, when the bursa is distended by fluid, there will be a bulging above the annular ligament, and another in the palm, with perceptible fluctuation between them; the unyielding ligament causing a kind of constriction in the centre.

In some very rare instances the bursa communicates with the

wrist joint. It communicates always with the synovial sheath of the long flexor tendon of the thumb, in most cases with that of the flexor tendons of the little finger, and but rarely with that of the index, middle and ring fingers. On this account, inflammation of the theca of the thumb or little finger, is more liable to be attended with serious consequences than either of the others.

85. The *lumbricales*, four slender muscles, one for each finger, are attached to the tendons of the flexor profundus in the palm. They are distinguished as first, second, third, and fourth, counting from the index finger, and all of them arise from the radial side of the deep flexor tendon of their corresponding finger: the third and fourth generally arise from the adjacent sides of two tendons. Each little muscle terminates in a broad thin tendon which passes over the radial side of the first joint of the finger, and is inserted into the expansion of the extensor tendon on the back of the finger. Their *action* is not satisfactorily determined; they may probably be of use in bending the first joint of the fingers. The number of these muscles is not always constant; it may be increased by one, in which case one finger, usually the ring, has two muscles, one on either side; or it may be diminished by one; sometimes one of them divides, so as to send a tendon to the opposite sides of two fingers.

86. *Muscles constituting the ball of the thumb.*—The most superficial of these is a broad flat muscle, the *abductor pollicis*. It arises from the os scaphoides, from the superficial fibres of the anterior annular ligament, and from an expansion derived from the tendon of the extensor ossis metacarpi pollicis. It is inserted by a flat tendon into the base of the radial side of the first phalanx of the thumb. A small *bursa* is sometimes found beneath its tendon. Its *action* is to draw the thumb forwards and inwards away from the index finger.

87. Reflect the abductor pollicis from its insertion. A strong and thick muscle lies beneath it, called the *flexor ossis metacarpi*, or *opponens pollicis*. It arises from the os trapezium and the anterior annular ligament, and is inserted by fleshy fibres into the whole length of the radial side of the metacarpal bone of the

thumb. The *action* of this muscle is to oppose the thumb to the fingers.

88. Reflect the flexor ossis metacarpi from its insertion, and be careful not to remove with it a muscle situated beneath it, and to its inner side, called the *flexor brevis pollicis*. This muscle has two distinct origins; one from the lower edge of the annular ligament and the os trapezium, the other from the os trapezoides, os magnum, and the upper end of the third metacarpal bone. The two portions of the muscle unite behind the tendon of the flexor longus pollicis, and again separate near the lower end of the metacarpal bone of the thumb into an external and internal part, the latter being the larger. The external division, closely connected with the opponens pollicis, ends in a tendon which is inserted into the radial side of the base of the first phalanx of the thumb; the internal division, intimately united to a muscle in the palm called the adductor pollicis, is inserted by a tendon into the ulnar side of the base of the first phalanx of the thumb. A large sesamoid bone is found in each of the tendons. The lower portions of the muscle are separated by the long flexor tendon of the thumb and the arteria magna pollicis. Its *action* is to bend the first phalanx of the thumb.

Cut through the flexor tendons and the median nerve about three inches above the annular ligament of the wrist, and turn them out of the carpal groove and from the palm. A good view is thus obtained of the synovial bursa of the carpus. Observe the extent of the bursa above and below the ligament, and the loose manner in which it is reflected over the bundle of tendons (see § 84.) Observe also the loose and abundant cellular tissue which lies under the tendons in the palm, allowing them to play freely over the deep palmar fascia.

89. The *deep palmar fascia* covers the interosseous muscles and the deep palmar arch of arteries. It is comparatively thin towards the carpus, but very strong lower down, where it is connected with the transverse ligament uniting the heads of the metacarpal bones. On either side it is connected with the central portion of the superficial palmar fascia, so as to form a large com-

partment in the palm, containing the flexor tendons and the principal vessels and nerves. Thus, when suppuration takes place in the loose cellular tissue surrounding the tendons, we can easily understand why it is so long prevented from reaching the surface, either in the palm, or on the back of the hand (see § 71.)

90. We have yet to examine in the palm a triangular muscle belonging to the thumb, called the *adductor pollicis*. It arises from the lower two-thirds of the shaft of the metacarpal bone of the middle finger; its fibres converge outwardly, and are inserted, along with the inner portion of the flexor brevis pollicis, into the ulnar side of the base of the first phalanx of the thumb. Its *action* is to draw the thumb towards the palm.

91. *Muscles constituting the ball of the little finger.*—The muscles of the little finger correspond in some measure with those of the thumb. Thus we have an abductor, a flexor brevis, and an opponens minimi digiti. They are covered by a thin layer of the palmar fascia, which must be removed.

92. The *abductor minimi digiti*, the most internal and superficial of the muscles of the little finger, arises from the pisiform bone and from the tendon of the extensor carpi ulnaris. It passes along the border of the palm, and is inserted by a flat tendon into the inner side of the base of the first phalanx of the little finger. Its *action* is to draw this finger from the rest.

93. The *flexor brevis minimi digiti* is a long slender muscle, situated along the radial side of the abductor, of which it might fairly be considered as a portion. It arises from the unciform bone and the annular ligament, and is inserted with the tendon of the abductor into the ulnar side of the base of the first phalanx of the little finger. Its *action* is similar to that of the abductor.

Between the origins of the abductor and flexor brevis minimi digiti, the deep branch of the ulnar artery, accompanied by its nerve, sinks down to assist in forming the deep palmar arch.

94. The two last muscles must be reflected from their insertion, in order to expose the muscle beneath them, called the *adductor*, or *opponens digiti minimi*. It arises from the unciform bone and the anterior annular ligament. The fibres increase in length and obliquity from above downwards, and are inserted along the ulnar

side of the shaft of the metacarpal bone of the little finger. Its *action* is to draw this bone, which is the most moveable of all the metacarpal bones of the fingers, towards the thumb. Thus it materially assists in forming a hollow in the palm.

Remove the deep palmar fascia, and clean the deep arch of arteries which lies, surrounded by more or less fat, over the upper ends of the metacarpal bones. Trace the branches of the radial artery in the palm.

95. *Branches of the radial artery in the palm.*—The radial artery, after passing over the external lateral ligament of the carpus, and beneath the extensor tendons of the thumb, towards the back of the hand, sinks into the angle between the metacarpal bones of the thumb and fore finger, and generally gives off three principal branches—the arteria magna pollicis, the radialis indicis, and the palmaris profunda; but the arrangement of all the arteries in the palm is subject to frequent varieties.

96. The *arteria magna pollicis* runs in front of the abductor indicis muscle (first dorsal interosseous), close along the ulnar border of the metacarpal bone of the thumb: in the interval between the lower portions of the flexor brevis pollicis, the artery divides, beneath the long flexor tendon, into two branches, which proceed, one on either side of the thumb, and inosculate at the apex of the last phalanx. Their distribution and mode of termination are similar to those of the other digital arteries.

97. The *arteria radialis indicis* descends along the radial side of the second metacarpal bone, between the abductor indicis and adductor pollicis muscles, at the lower border of which it becomes superficial, and continues its course along the radial side of the index finger to the extremity, where it forms an arch with the other digital artery. Near the lower margin of the adductor pollicis, the radialis indicis generally receives a branch from the superficial palmar arch.

98. The *palmaris profunda* is sometimes considered as the continuation of the radial artery. It enters the palm between the inner origin of the flexor brevis and the adductor pollicis muscles, describes a curve, with the concavity towards the wrist, across the upper ends of the second, third, and fourth metacarpal bones, and inosculates

with the deep branch of the ulnar artery, which thus completes the deep palmar arch. From the curve of the arch small branches ascend to supply the bones and joints of the carpus, inosculating with the other carpal arteries. From the convexity of the arch three or four small branches, called *palmar interosseous*, descend to supply the interosseous muscles, and near the clefts of the fingers communicate with the digital arteries. These palmar interosseous branches are sometimes of considerable size, and take the place of one or more of the digital arteries, ordinarily derived from the superficial palmar arch.

a. Other branches, called the *perforating arteries*, are derived from the deep palmar arch. They pass between the upper ends of the metacarpal bones to the back of the hand, and there communicate with the carpal branches of the radial and ulnar arteries.

99. The *deep palmar branch of the ulnar nerve* sinks into the palm with the ulnaris profunda artery, between the abductor and flexor brevis minimi digiti muscles. It then crosses obliquely over the deep palmar arch towards the radial side of the palm, and disappears beneath the adductor pollicis.

Between the pisiform and unciform bones, the nerve gives a branch to each of the muscles of the little finger. Subsequently, filaments are sent to each interosseous muscle, and generally to the two internal lumbricales. Small filaments also accompany the perforating arteries to the back of the hand, and join the dorsal cutaneous branches of the ulnar and radial nerves. But the largest branches supply the adductor pollicis and abductor indicis muscles, and in some cases also the flexor brevis pollicis.

The dissection of the remaining muscles of the palm, called, from their position, *interossei*, must be for the present postponed (see § 150.)

DISSECTION OF THE MUSCLES OF THE BACK CONNECTED WITH THE ARM.

100. Make an incision through the skin over the spine from the occiput to the sacrum; another from the last dorsal vertebra,

upwards and outwards to the spine of the scapula, and thence along its spine to the acromion ; and a third from the middle of the sacrum upwards and outwards for a short distance over the crest of the ilium. Reflect the skin from the dense subjacent superficial fascia.

101. The *cutaneous nerves of the back* are derived from the posterior branches of the spinal nerves ; these branches, after supplying the muscles contained in the vertebral groove, pass through them and become subcutaneous in nearly a regular series, on either side of the spine, but not all at an equal distance from it. Thus in the cervical and upper dorsal region, the cutaneous nerves perforate the trapezius close to the spine : in the lower dorsal and the lumbar region, they perforate the latissimus dorsi in a line nearly corresponding to the angles of the ribs. Each cutaneous nerve then divides into internal and external branches, which supply the integument of the respective regions of the back to which they belong. Most of them are accompanied by small arteries. As might be expected, the external branches are by far the larger, especially in the loins, where some of them descend over the crest of the ilium, and terminate in the skin of the buttock.

Of these cutaneous nerves we need notice only the following :—

102. The *posterior branch of the second cervical nerve* is called from its distribution the *great occipital*. It perforates the complexus, ascends over the occiput, and ramifies upon the under surface of the scalp, in company with the branches of the occipital artery.

The *cutaneous branch of the third cervical nerve* also sends a branch of considerable size to the back of the scalp.

The *cutaneous branch of the second dorsal nerve* is generally the largest of all the dorsal cutaneous nerves. It may be traced outwards towards the spine of the scapula.

The *posterior branch of the second lumbar nerve* perforates the fascia lumborum near the posterior superior spine of the ilium, and descends over the crest of the ilium to supply the skin over the glutæal region.

Clean the superficial layer of the muscles of the back. Those with which we are now more immediately concerned are, the trapezius and the latissimus dorsi.

103. The *trapezius* is a broad flat muscle situated immediately beneath the skin of the cervical and upper part of the dorsal region. Taken alone it is triangular, but with its fellow of the opposite side it presents a trapezoid form. It arises by aponeurotic fibres from the spine of the occiput, and from the inner fourth, more or less, of its superior curved line; from the ligamentum nuchæ, and from the spinous processes of the seventh cervical, and all the dorsal vertebrae, as well as the interspinous ligaments. The fibres converge towards the shoulder. The upper are inserted fleshy into the external third of the clavicle; the middle, into the upper border of the acromion process and spine of the scapula; the lower terminate in a broad thin tendon, which plays over the triangular surface at the back of the scapula, and is inserted into the beginning of the spine. A *bursa* is frequently found between the tendon and the bone. The insertion of the trapezius exactly corresponds to the origin of the deltoid, and the two muscles are more or less connected by a thin aponeurosis over the spine and acromion process of the scapula. If both the trapezius muscles be exposed, it will be observed, that, between the sixth cervical and the third dorsal vertebra, their origin presents an aponeurotic space of an elliptical form.

Action.—The fixed point of the muscle is at the vertebral column, and all its fibres tend to raise the shoulder. The deltoid cannot raise the humerus to an angle of more than 50° : beyond this the elevation of the arm is principally effected by the action of the trapezius upon the scapula. It is necessarily in strong action when a weight is born upon the shoulders.

102. The *ligamentum nuchæ* is a structure consisting of dense fibrous tissue, which extends from the spine of the occiput to the spinous process of the last cervical vertebra. In some subjects it is difficult to distinguish it from the aponeurosis of the trapezius which arises from it; in others it is more conspicuous, and may be traced down to the spinous processes of the five or six lower cervical vertebrae, forming a more or less complete partition between the muscles at the back of the neck. It is a rudiment of the great elastic cervical ligament of quadrupeds which sustains the weight of the head.

105. The *latissimus dorsi* is a broad flat muscle which occupies the lumbar and the lower half of the dorsal region, and thence extends to the arm, where it forms part of the posterior boundary of the axilla. It arises by tendinous fibres from the posterior third of the external margin of the crest of the ilium, from a broad aponeurosis in the lumbar region called the *fascia lumborum*, from the spinous processes of the six inferior dorsal vertebrae, beneath the trapezius, and, lastly, from the three or four lower ribs by fleshy digitations, which correspond with those of the external oblique muscle of the abdomen. The upper fibres pass almost transversely outwards over the inferior angle of the scapula; those lower down ascend, gradually increasing in obliquity, while those which arise from the ribs are nearly vertical. In this way, all the fibres converge towards the axilla, where they form a thick muscle, which folds beneath the teres major, and is inserted by a broad flat tendon into the bottom of the bicipital groove of the humerus. The tendon is about two inches broad, and lies in front of that of the teres major, from which it is separated by a large *bursa*. Its lower part receives the transverse muscular fibres, and its upper part those which are more vertical, so that the muscle has a somewhat twisted appearance at the axilla. The tendon sends off an expansion to the fascia of the arm.

The *latissimus dorsi* often receives a distinct accessory slip from the inferior angle of the scapula.

Action.—It draws the humerus inwards and backwards: it also co-operates with the pectoralis major in pulling any object towards the body: if the humerus be the fixed point, it will raise the body, as in the act of climbing. The transverse fibres of the muscle keep the inferior angle of the scapula in proper position. It sometimes happens that the scapula slips above the muscle: this displacement is readily recognized by the unnatural projection of the lower angle of the bone, and the impaired movements of the arm.

Between the base of the scapula, the trapezius, and the upper border of the *latissimus dorsi*, a triangular space is observed in certain positions of the arm, in which the lower fibres of the rhomboideus major, and part of the sixth intercostal space, are exposed.

Immediately above the crest of the ilium, between the free margins of the latissimus dorsi and external oblique muscles, there is commonly an interval in which the internal oblique is exposed.

106. The *fascia lumborum* is a dense shining aponeurosis in the lumbar region, thin and pointed at its upper part, broader and very strong at its lower. It consists of an intertexture of tendinous fibres, which are attached to the spines of the six or seven lower dorsal, all the lumbar and sacral vertebræ, and to the posterior part of the crest of the ilium. It is the common bond of attachment of the latissimus dorsi, the serratus posticus inferior, and the internal oblique and transverse muscles of the abdomen, and it forms the posterior part of the sheath of the great erector spinæ. Make a vertical incision through the fascia, and reflect it in order to see how inseparably it is connected on the outer side of the erector spinæ with the tendons of the internal oblique and transversalis which pass in front of the erector spinæ to the transverse processes of the lumbar vertebræ.

Reflect the trapezius from its origin. On its under surface will be observed the ramifications of a small artery, called the *superficialis colli* (a branch of the posterior scapular). A large nerve, the *spinal accessory*, also enters its under surface near the clavicle, and then divides into filaments, some of which ascend, others descend in its substance.

107. The *spinal accessory nerve* is one of the three divisions of the eighth pair of cerebral nerves. It arises from the posterior and lateral part of the cervical portion of the spinal cord by several roots, of which the lowest are opposite the fourth cervical vertebra. Formed by the union of these roots, the nerve enters the skull through the foramen magnum, and leaves it again through the foramen jugulare. It then descends behind the internal jugular vein, traverses obliquely the upper third of the sterno-mastoid muscle, and crosses the posterior triangle of the neck to reach the trapezius, in which it terminates.

The trapezius is also supplied by one or two branches of the cervical plexus, which communicate in its substance with the nervus accessorius.

Beneath the trapezius there remain to be examined four muscles

connected with the scapula, namely, the levator anguli scapulæ, the omo-hyoideus, and the rhomboideus major and minor. In order to clean these muscles, the scapula must be adjusted so as to stretch their muscular fibres.

108. The *levator anguli scapulæ* is situated at the posterior and lateral part of the neck. It arises by three or four tendons from the posterior tubercles of the transverse processes of the three or four upper cervical vertebræ. The tendons are situated between those of the scalenus posticus in front, and the splenius colli behind. That portion of the muscle which comes from the atlas is always the largest, and is frequently attached to the bone by fleshy fibres. The muscular slips to which the tendons give rise, unite and form a single muscle, which descends backwards down the side of the neck, and is inserted into the posterior border of the scapula between its spine and superior angle. Its *action* is to raise the posterior angle of the scapula; as, for instance, in shrugging the shoulders.

One or two branches of the cervical plexus of nerves enter the upper part of the levator anguli scapulæ; sometimes there is a distinct nerve for each slip of the muscle. Its scapular end is also supplied by a filament from a nerve of considerable size which lies beneath it, and passes on to supply the rhomboid muscles.

109. The *rhomboideus major* and *minor* are two flat muscles which extend rather obliquely from the spinous processes of the vertebræ to the base of the scapula. They often appear like a single muscle, but, commonly, there is a division between them. The *rhomboideus minor*, situated the higher of the two, arises by a thin aponeurosis from the spinous processes of the last cervical and the first dorsal vertebra, and is inserted into the base of the scapula opposite its spine. The *rhomboideus major* arises by tendinous fibres from the spinous processes of the four or five upper dorsal vertebræ, and from the interspinous ligaments, and is inserted by fleshy fibres into the base of the scapula between its spine and inferior angle. In some cases the middle fibres are not inserted immediately into the bone, but into a thin tendon which runs parallel with the base of the scapula, adhering to it only at both ends. The *action* of these muscles is to draw the scapula upwards and backwards, and fix it upon the chest.

The *nerve of the rhomboid muscles* is a branch of the fifth cervical nerve. It passes outwards beneath the lower part of the levator anguli scapulæ, to which it sends a filament, and is lost in the under surface of the rhomboid muscles.

110. The *omo-hyoid* muscle extends from the scapula to the os-hyoides, and consists of two narrow muscular portions, connected by an intermediate tendon beneath the sterno-mastoid muscle. The posterior portion only can be seen in the present dissection. It arises from the superior costa of the scapula, close behind the notch, and from the ligament above the notch. From thence the slender muscle, concealed at first by the trapezius, passes forwards across the lower part of the neck, as far as the under surface of the sterno-mastoid muscle, where it changes its direction and ascends nearly vertically, to be attached to the os-hyoides at the junction of the body with the greater cornu. Thus the two portions of the muscle form beneath the sterno-mastoid an obtuse angle of which the apex is tendinous, and of which the angular direction is maintained by a strong layer of fascia, proceeding from the tendon to the first rib and the clavicle. Its *action* is to depress the os-hyoides. A more complete description of this muscle is given in the dissection of the neck.

111. The *supra-scapular artery*, (transversalis humeri,) a branch of the thyroid axis, will be found nearly parallel with, but rather below the posterior division of the omo-hyoid muscle. It runs near the under surface of the clavicle to the supra-scapular notch, through which it passes to supply the supra-spinatus and infra-spinatus muscles. It sends off in its course the *supra-acromial* branch, which perforates the trapezius, and ramifies upon the acromion, anastomosing with the other acromial arteries derived from branches of the axillary. The supra-scapular vein terminates either in the subclavian or in the external jugular vein.

The *supra-scapular nerve*, a branch of the fifth or sixth cervical nerve, takes the same course as the corresponding artery, and is distributed to the supra-spinatus and infra-spinatus muscles.

112. The *posterior scapular*, a large tortuous artery, is seen near the upper angle of the scapula. It is a continuation of the artery called the transversalis colli, which commonly arises from the

thyroid axis, but often separately from the subclavian either on the inner or the outer border of the scalenus anticus muscle, and runs backwards across the lower part of the neck, above, or between the trunk nerves of the brachial plexus, towards the posterior superior angle of the scapula. In this situation it takes the name of posterior scapular, and is seen pursuing its course beneath the levator anguli scapulæ and the rhomboid muscles under cover of the posterior border of the scapula. Divide the rhomboid muscles near their insertion and trace the artery to the inferior angle of the scapula, where it terminates in ramifications which supply the rhomboid and serratus magnus muscles.

Numerous muscular branches arise from this artery. One, called the *superficialis colli*, is given off near the upper angle of the scapula, and supplies chiefly the trapezius, in the substance of which it communicates with small branches which descend from the occipital artery.

The posterior scapular vein generally terminates in the subclavian or in the external jugular.

Divide the latissimus dorsi below the inferior angle of the scapula, and examine the serratus magnus. To see the full extent of this muscle, draw the posterior border of the scapula forcibly outwards, and divide the loose cellular tissue which intervenes between it and the ribs. The great abundance of cellular tissue in this situation is necessary for the free play of the scapula on the side of the chest.

113. The *serratus magnus* is a broad flat muscle which intervenes between the scapula and the ribs. It arises by distinct fleshy digitations from the external surfaces of the eight or nine upper ribs, about three inches, more or less, from their cartilages : a well-marked rib has generally an oblique ridge which indicates the attachment of the digitation. The digitations vary in size, and exceed by one the number of ribs from which they arise—since the second rib usually gives origin to two. The upper digitations also arise from aponeurotic arches over the two first intercostal spaces. The four lower ones, increasing in length and obliquity, correspond with those of the external oblique muscle of the abdomen. All the fibres pass backwards, converging to the posterior border of the

scapula. The upper portion of the muscle, which is the shortest and thickest, is inserted into the internal surface of the scapula, immediately below its superior angle; the middle, which is the weakest, is inserted by short aponeurotic fibres into the base of the scapula, between the rhomboid and subscapular muscles; the lower is inserted into the internal surface of the inferior angle of the scapula.

Action.—This is the most important of all the muscles which regulate the movements of the scapula on the chest; it counteracts all forces which tend to push the scapula backwards; by drawing the scapula forwards, it gives us two or three additional inches in the reach of the arm. Supposing the fixed point to be at the scapula, some anatomists ascribe to it the power of raising the ribs: hence Sir Charles Bell called it the external respiratory muscle, as opposed to the internal respiratory muscle, the diaphragm.

The nerve which supplies the muscle is a branch of the fifth and sixth cervical nerve: it descends along its outer surface (see § 15).

Divide the serratus magnus near the scapula, and remove the arm by sawing through the middle of the clavicle, and cutting through the axillary vessels and nerves. These should subsequently be tied to the coracoid process. After the removal of the arm, the precise insertion of the preceding muscles into the scapula should be carefully examined.

DISSECTION OF THE MUSCLES OF THE SHOULDER.

114. Remove the skin from the shoulder: the subcutaneous tissue over its anterior surface gives origin to a few fibres of the platysma myoides. A small absorbent gland is, in some few instances, found over the insertion of the deltoid.

The *cutaneous nerves of the shoulder* are derived partly from the branches of the cervical plexus which descend over the acromion, (see § 2), and partly from the circumflex nerve, of which one or two branches turn round the posterior border of the deltoid, and others, smaller, perforate the muscle, each accompanied by a small artery.

The thin layer of fascia observed upon the surface of the deltoid extends from the strong aponeurosis covering the muscles on the dorsum of the scapula, and is continuous with the fascia of the

arm. It dips down between the fibres of the muscle, dividing it into large bundles, and giving it a coarse appearance.

115. *The deltoid muscle.*—The great triangular muscle which covers the shoulder-joint is named deltoid, from its supposed resemblance to the Greek Δ reversed. It arises from the external third of the clavicle, from the outer border of the acromion, and from the spine of the scapula down to the triangular surface at its root. This origin, which corresponds precisely to the insertion of the trapezius, is tendinous and fleshy every where, except at the commencement of the spine of the scapula, where it is simply tendinous, and connected with the infra-spinous aponeurosis. The muscular fibres descend, the anterior backwards, the posterior forwards, and the middle perpendicularly, so that all converge to a tendon which is inserted into a rough surface a little above the middle of the outer part of the humerus. The insertion of the tendon cannot be fully seen till the muscle is reflected. It extends one inch and a half along the humerus, and terminates in a \vee shaped form, the origin of the brachialis anticus being on either side. Sometimes a few fibres of the pectoralis major are connected with its front border.

The arrangement of the muscular bundles composing the deltoid is peculiar; a peculiarity arising from its broad origin and its comparatively narrow insertion. They are collected into triangular bundles of different sizes, of which the greater number and the larger have their bases at the origin of the muscle, and their apices towards the insertion. The intervals between these are occupied by smaller triangular bundles with their bases downwards. This arrangement requires the interposition of tendons between the bundles for the attachment of the muscular fibres. Accordingly, we find that three or four tendons descend from the acromion, and give origin to those triangular bundles of which the bases are downwards: on the other hand, prolongations from the tendon at the humerus ascend into the muscle, and receive the insertion of those bundles of which the bases are upwards.

The action of the muscle is not only concentrated upon one point, but its power is also greatly increased, by this arrangement.

Action.—It raises the arm; but it cannot do so to a greater

angle than 50°. The elevation of the arm beyond this angle, is effected through the elevation of the shoulder by means of the trapezius. Its anterior fibres draw the arm forwards; the posterior, backwards.

Reflect the deltoid from its origin; observe the aponeurotic septa between its bundles of fibres; also the broad tendon of insertion into the humerus, and the pointed processes which ascend from it into the muscle. It is now seen how the muscle forms a complete protection to the shoulder-joint; how it covers the coraco-acromial ligament, the head, neck, and upper part of the humerus, as well as the tendons inserted into the greater tuberosity.

116. A *bursa* of very considerable size is situated between the deltoid, and the head of the humerus. It extends for some distance beneath the acromion and the coraco-acromial ligament, and covers the greater tuberosity of the humerus. In some instances it communicates by a wide opening with the shoulder-joint. Its use is to facilitate the movements of the head of the bone under the projecting arch, formed by the acromion and the coraco-acromial ligament. There may be two or more distinct bursal sacs over the head of the bone.

117. After the removal of the thin fascia from the under surface of the deltoid muscle, a complete view is obtained of the course of the circumflex artery and nerve. The *posterior circumflex artery* (see § 22) is given off from the axillary above the tendon of the latissimus dorsi: it passes backwards behind the surgical neck of the humerus, through a quadrilateral opening, bounded above by the subscapularis, below by the teres major, externally by the neck of the humerus, and internally by the long head of the triceps. The artery then winds round the neck of the bone to the under surface of the deltoid, in which its larger branches terminate, anastomosing with the ramifications of the anterior circumflex and acromial thoracic arteries.

From the posterior circumflex artery, a branch commonly descends in the substance of the long head of the triceps, to anastomose with the superior profunda; other small arteries ascend to supply the shoulder-joint and the head of the humerus, and some

perforate the deltoid, to join the delicate network of vessels upon the acromion.

a. The *circumflex nerve*, a branch of the axillary plexus, takes the same course as the artery, but is situated nearer to the head of the humerus. It sends a branch to the teres minor, one or two to the integuments of the shoulder, and terminates in the substance of the deltoid, in branches which accompany the ramifications of the circumflex artery. The proximity of this nerve to the head of the humerus explains the occasional occurrence of paralysis of the deltoid, after a dislocation of this bone into the axilla.

118. The muscles on the dorsum of the scapula are covered by a strong aponeurosis, which is firmly attached to the spine and borders of the bone. At the posterior edge of the deltoid, it divides into two layers, one of which passes over, the other under, the muscle. The superficial layer is continuous with the general fascia of the arm; the deep layer is continued over the head of the humerus to the short head of the biceps and coraco-brachialis muscles, and thence over the axillary vessels. Remove the aponeurosis from the muscles, so far as this can be done without injury to the muscular fibres which arise from its under surface.

119. The *infra-spinatus* muscle, triangular in form, arises by fleshy and tendinous fibres from the lower surface of the spine, and the greater part of the dorsum of the scapula, below the spine, excepting the neighbourhood of the neck; also from the back part of the strong fascia covering its surface, as well as that which separates it from the teres minor. The fibres converge to a tendon, which is at first contained in the substance of the muscle, and then proceeds over the capsular ligament of the shoulder-joint, to be inserted into the upper and back part of the greater tuberosity of the humerus.

120. The *teres minor* is a long narrow muscle, situated below the infra-spinatus, along the inferior border of the scapula. It arises from a smooth surface, about three inches long, on the dorsum of the scapula, close to the inferior border, and from its own fascial covering. The fibres ascend parallel with those of the infra-spinatus, and terminate in a broad flat tendon, which is contained

at first in the substance of the muscle, and then, passing behind the capsular ligament of the shoulder-joint, is inserted into the posterior and lower part of the greater tuberosity of the humerus. Some of the fibres of the muscle are attached directly into the bone. A branch of the circumflex nerve enters its inferior surface. A *bursa* sometimes intervenes between the tendon and the tuberosity.

The *action* of the infra-spinatus and teres minor is to rotate the humerus outwards.

121. The *teres major* muscle, situated below the teres minor, is closely connected with the latissimus dorsi, and extends from the inferior angle of the scapula to the humerus, contributing to form the posterior boundary of the axilla. It arises from the flat surface at the inferior angle of the dorsum of the scapula, and from the septum which separates it from the infra-spinatus and teres minor. The muscular fibres terminate upon a broad flat tendon, two inches or more in breadth, which is inserted into the inner edge of the bicipital groove of the humerus, behind the tendon of the latissimus dorsi. Its *action* is to draw the humerus backwards. By dissecting between the two tendons, it will be found that they are separated, near the groove, by a large *bursa*, and that the tendon of the latissimus dorsi is inserted into the bottom of the groove. The tendon of the teres major descends lower than that of the latissimus dorsi, and has commonly a separate *bursa* between itself and the bone.

Remove the trapezius from its insertion into the clavicle and spine of the scapula, and we shall then expose a layer of fascia, which is attached to the margins of the supra-spinal fossa, and covers the supra-spinatus muscle. This fascia must be removed.

122. The *supra-spinatus* muscle arises from the posterior two-thirds of the supra-spinal fossa, and from the posterior part of its aponeurotic covering. It passes underneath the acromion, over the upper part of the shoulder-joint, and is inserted by a strong broad tendon into the highest part of the greater tuberosity of the humerus. To obtain a good view of its insertion, the acromion process should be sawn off near the neck of the scapula. The tendon lies concealed in the muscle, and is closely connected with

the capsule of the joint. *Action.*—It assists the deltoid in raising the arm.

123. The *subscapularis* muscle is covered by a thin layer of fascia, which is attached to the borders of the scapula. It is triangular, and occupies the subscapular fossa. It arises from the posterior three-fourths of the fossa, from three or four tendinous septa attached to the oblique ridges on its surface, and from the axillary border of the bone. The bundles of the muscle converge towards the neck of the scapula, where they terminate upon three or four tendons, which are concealed amongst the muscular fibres, and are inserted into the lesser tuberosity of the humerus. Its broad insertion is closely connected with the capsule of the shoulder-joint, which it completely protects upon its inner side. Some of the fibres of the thick inferior border of the muscle are inserted fleshy into the neck of the humerus below the tuberosity. Its *action* is to rotate the humerus inwards.

The nerves (two or three in number) which supply the *subscapularis* are derived from the great cord which gives off the circumflex and musculo-spiral nerves.

The coracoid process, with the *coraco-brachialis* and short head of the biceps, form a kind of arch, under which the tendon of the *subscapularis* plays. There are several *bursæ* about the tendon. There is one of considerable size on the upper surface of the tendon, to facilitate its motion beneath the coracoid process and the *coraco-brachialis*: this sometimes communicates with the large bursa under the deltoid. Another is situated between the tendon and the root of the coracoid process. A third is situated between the tendon and the capsule of the joint, and almost invariably communicates with it. In some subjects the last two *bursæ* are united into one.

Reflect the muscles from the surfaces of the scapula, in order to trace the arteries which ramify upon the bone. Observe that a few fibres from each are lost upon the capsular ligament of the shoulder-joint. These fibres prevent the capsule from folding inwards during the movements of the head of the humerus upon the glenoid cavity.

124. Trace the continuation of the *supra-scapular artery* (see § 111). It passes above, or, less frequently, through the notch of the scapula, into the supra-spinal fossa; sends a branch to the supra-spinatus, and another to the shoulder-joint; and then descends over the neck of the scapula into the fossa below the spine, where it inosculates directly with the dorsalis scapulæ. Its numerous branches ramify upon the bone, and supply the infra-spinatus and teres minor muscles.

The supra-scapular nerve passes most frequently through the notch of the scapula, accompanies the corresponding artery, and supplies the supra and infra-spinatus muscles.

125. The *dorsal branch of the infra-scapular artery* (dorsalis scapulæ, see § 20) passes backwards through a triangular interval, bounded superiorly by the subscapularis, inferiorly by the teres major, and in front by the long head of the triceps. Having reached the dorsum of the scapula, it ascends, close to the bone, and anastomoses with the supra-scapular artery. It sends a branch, which runs between the origins of the teres major and minor, to the inferior angle of the scapula, and another which ramifies in the subscapular fossa.

The frequent communications about the scapula between the branches of the subclavian and axillary arteries, would furnish a free current of blood to the arm if the subclavian were tied above the clavicle.

126. *Triceps extensor cubiti*.—The origins of this muscle, which were only partially seen in the dissection of the upper arm (see § 38), should now be more fully examined. The long head is attached to a rough surface about an inch long, immediately below the glenoid cavity of the scapula, by a strong tendon which is thickest at its upper part, where it is connected with the capsule of the shoulder-joint. The tendon divides into two layers, of which the internal is prolonged for some distance, to afford increased surface for the origin of muscular fibres. The long head then descends, between the teres major and minor, along the posterior part of the humerus.

The second or external head arises, by aponeurotic fibres, from

the outer and posterior part of the humerus, commencing at a point below the insertion of the teres minor, and descending down to the middle of the bone ; also from the upper two-thirds of the external intermuscular septum.

The third or internal head arises from the inner and posterior part of the humerus, commencing at a point below the teres major, and extending down to the elbow ; also from the internal intermuscular septum. The precise origin of these heads from the humerus may be ascertained by following the superior profunda artery and musculo-spiral nerve, which intervene between them. The three portions of the muscle terminate upon a broad tendon, which covers the back of the elbow-joint, and is inserted into the summit and sides of the olecranon ; it is also connected with the fascia on the back of the fore-arm. Between the tendon and the olecranon is placed a *bursa*, commonly of small size, but sometimes so large as to extend upwards behind the capsule of the joint : in some rare instances, a communication has been seen between them.

The tendon of the triceps commences as a broad expansion high up in the muscle, and is subcutaneous for several inches above the elbow. It receives the muscular fibres of the long head chiefly along the inner part of its superficial surface, nearly down to the olecranon. The fibres of the external head terminate upon the higher part of its deep surface, and those of the internal head upon the lower part. A few of the muscular fibres are implanted directly into the olecranon, and some of them pass behind the external condyle to the back of the fore-arm, and are inseparably united with a muscle called the anconeus. The *action* of the triceps is to extend the fore-arm.

By dividing the triceps transversely a little above the elbow, and turning down the lower portion, it will be observed that some of the muscular fibres which arise from the humerus above the fossa for the olecranon terminate upon the capsule of the joint. They have been described by some anatomists as a distinct muscle, under the name of *subanconeus* ; their use is to draw up the capsule, so that it may not be injured during extension of the arm. The

subanconeus is in this respect analogous to the subcruræus muscle of the thigh. Observe the *bursa* under the tendon, and the numerous arteries which ramify upon the back part of the capsule of the joint.

Trace the continuation of the superior profunda artery (see § 40) and musculo-spiral nerve (see § 39) round the posterior part of the humerus. They lie close to the bone, and are protected by an aponeurotic arch thrown over them by the external head of the triceps : here the nerve is placed between the two principal branches of the artery. Observe the branches given off by the nerve to each of the three portions of the triceps, and follow the long branch of the superior profunda artery through the substance of the triceps to the olecranon.

DISSECTION OF THE BACK OF THE FORE-ARM.

127. Remove the skin from the back of the fore-arm, hand, and fingers. Observe the subcutaneous *bursa* over the olecranon. It is commonly of considerable size, and, if distended, would appear nearly as large as a walnut. Another *bursa* is sometimes found a little lower down upon the ulna. A subcutaneous *bursa* is generally placed over the internal condyle, and another over the external. A *bursa* is also situated over the styloid process of the ulna ; this sometimes communicates with the sheath of the extensor carpi ulnaris. Small *bursæ* are sometimes developed in the cellular tissue over each of the knuckles.

The cutaneous veins from the back of the hand and fore-arm join the venous plexus at the bend of the elbow (see § 45).

128. *Subcutaneous nerves of the back of the fore-arm.*—They are the external cutaneous branches of the musculo-spiral nerve, the posterior branch of the internal cutaneous nerve (see § 46), and slender filaments from the external cutaneous (see § 34). The greater number of these nerves may be traced down to the back of the wrist.

129. *Subcutaneous nerves on the back of the hand, thumb, and fingers.*—The skin on the back of the hand is united to the subjacent tendons by an abundance of loose cellular tissue, in which

we find large veins, and branches of the radial (see § 59, *a b*) and ulnar nerves (see § 62 *a*). The veins are generally situated beneath the nerves.

The dorsal branch of the ulnar nerve passes very obliquely beneath the tendon of the flexor carpi ulnaris, and over the internal lateral ligament of the wrist; and divides upon the back of the hand into filaments, which become the dorsal nerves of the little finger, the ring finger, and the ulnar side of the middle finger.

The radial nerve passes obliquely beneath the tendon of the supinator longus, and subdivides into branches, which supply both sides of the back of the thumb and fore-finger, and the radial side of the middle finger. This last branch always communicates with a filament from the ulnar nerve.

The relative share which the radial and ulnar nerves take in supplying the fingers, is not the same in all cases. Under any arrangement, the thumb and each finger has two dorsal nerves, one on either side, of which the terminal branches reach the root of the nail. They supply filaments to the skin on the back of the finger, and have frequent communications with the palmar digital nerves. In some instances, one or more of the dorsal nerves do not extend beyond the first phalanx; their place is then supplied by a branch from the palmar nerve.

131. The *fascia on the back of the fore-arm* is composed of fibres interlacing in various directions, and is thicker and stronger than that upon the front surface of the fore-arm. It is attached to the two condyles of the humerus and to the olecranon, and is strengthened by an expansion from the tendon of the triceps. Along the fore-arm it is attached to the ridge on the posterior part of the ulna. Its upper third gives origin to the fibres of the muscles beneath it, and separates them by septa, to which their fibres are also attached.

Posterior annular ligament.—This should not be considered as a distinct ligament, but rather as a part of the fascia of the fore-arm, strengthened by oblique aponeurotic fibres near the back of the wrist in order to confine the extensor tendons. These fibres are firmly attached to the styloid process of the radius, and thence pass obliquely inwards to the inner side of the wrist, where they

are connected with the pisiform bone and the anterior annular ligament of the carpus. Observe that they pass below the styloid process of the ulna, to which they are in no way attached, otherwise the rotation of the radius would be impeded.

From the deep surface of this so-called ligament, processes are attached to the ridges on the back of the radius, so as to form as many as six distinct sheaths for the passage of the extensor tendons. Counting from the radius towards the ulna, the first sheath contains the tendons of the extensor ossis metacarpi and the extensor primi internodii pollicis; the second contains the tendons of the extensor carpi radialis longior and brevior; the third contains the tendon of the extensor secundi internodii pollicis; the fourth contains the tendons of the indicator and the extensor communis digitorum; the fifth contains the tendon of the extensor minimi digiti; and the sixth, the tendon of the extensor carpi ulnaris. All the sheaths are lined by synovial membranes, to facilitate the play of the tendons. In a few instances, one or more of them communicate with the wrist-joint.

The *fascia of the metacarpus* consists of a thin fibrous layer continued from the posterior annular ligament. It separates the extensor tendons from the subcutaneous veins and nerves, and is attached to the radial side of the second metacarpal bone, and the ulnar side of the fifth.

131. *Superficial muscles on the back of the fore-arm.*—The fascia must be removed from the muscles, so far as this can be done without injuring the muscular fibres which arise from its under surface. Preserve the posterior annular ligament. The following muscles are now exposed, and should be examined in the order in which they are placed, proceeding from the radial to the ulnar side of the fore-arm:—

- The supinator radii longus (already described, § 54).
- The extensor carpi radialis longior.
- The extensor carpi radialis brevior.
- The extensor communis digitorum.
- The extensor minimi digiti.
- The extensor carpi ulnaris.
- The anconeus.

A little below the middle of the fore-arm, the extensors of the wrist and fingers diverge from each other, leaving an interval, in which are seen the three extensors of the thumb—the extensor ossis metacarpi pollicis, the extensor primi internodii pollicis, and the extensor secundi internodii pollicis. The two former cross the radial extensors of the wrist, and pass over the lower third of the radial border of the fore-arm; a small portion of the latter commonly appears on the outer side of the extensor communis digitorum.

Between the second and third extensors of the thumb, we observe a part of the lower end of the radius, which is not covered either by muscle or tendon. This subcutaneous portion of the bone is immediately above the prominent tubercle in the middle of its lower extremity, and, since it can be easily felt through the skin, it presents a convenient place for examination in doubtful cases of fracture.

132. The *extensor carpi radialis longior* muscle is partly covered by the supinator radii longus. It arises from the lower third of the ridge leading to the external condyle of the humerus, and from the intermuscular septum which separates it from the triceps. The muscle descends over the front surface of the capsule of the elbow-joint, along the outer side of the fore-arm, and terminates about, or a little above, the middle, in a broad flat tendon, which passes beneath the extensor ossis metacarpi and primi internodii pollicis, traverses a groove on the outer and back part of the radius, lined by a distinct synovial membrane, and is inserted into the posterior part of the carpal end of the metacarpal bone of the index finger. Previously to its insertion, the tendon lies on the capsular ligament of the wrist, and is crossed by the extensor secundi internodii pollicis. Reflect this muscle from its origin, in order to see the following, which is situated beneath it.

133. The *extensor carpi radialis brevior* muscle arises from the external condyle, from part of the external lateral ligament of the elbow, and from a strong aponeurosis, which is continued for some distance on its deep surface. The muscular fibres terminate near the middle of the fore-arm, upon the under surface of a broad flat tendon, which descends, covered by that of the extensor carpi

radialis longior, beneath the first two extensors of the thumb. Near the wrist, the tendon becomes more superficial, and traverses a groove on the back of the radius, on the same plane with that of the long radial extensor, but lined by a separate synovial membrane. The tendon then passes over the wrist-joint, where it is crossed by the third extensor of the thumb, and is inserted into the carpal end of the metacarpal bone of the middle finger. A *bursa* is generally found between the tendon and the bone.

Near its origin, the extensor carpi radialis brevior is in contact with the outer part of the capsule of the elbow-joint. In the upper third of the fore-arm, it lies upon the supinator radii brevis, a small *bursa* intervening near the head of the radius; in the lower two-thirds of the fore-arm it covers the insertion of the pronator teres, and the back of the radius. The *action* of the radial extensors of the wrist is implied by their name.

134. The *extensor digitorum communis* muscle arises from the common tendon attached to the external condyle, from the septa between it and the contiguous muscles, and from its strong fascial covering. About the middle of the fore-arm the muscle divides into three or four fleshy slips, terminating in as many flat tendons, which pass beneath the posterior annular ligament, through a groove on the back of the radius lined by synovial membrane. On the back of the hand they become broader and flatter, and diverge from each other towards the metacarpal joints of the fingers, where they become thicker and narrower, and give off on each side a fibrous expansion, which covers the sides of the joint. Over the first phalanx of the finger, each tendon again spreads out, receives the expanded tendons of the lumbricales and interossei muscles, and divides at the second phalanx into three portions, of which the middle is inserted into the upper end of the second phalanx; the two lateral, reuniting over the lower end of the second phalanx, are inserted into the upper end of the third.

A small *bursa* is generally found between the tendons and the metacarpal joints; and a patella-like piece of cartilage, or even bone, is in some few instances developed in the central portion of the tendon as it passes over the second joint of the finger.

Observe the oblique aponeurotic slips which connect the tendons

on the back of the hand. They are subject to great variety. The tendon of the index finger is commonly free; it is situated on the radial side of the proper indicator tendon, and becomes united with it at the metacarpal joint.

The tendon of the middle usually receives a slip from that of the ring finger. The tendon of the ring finger generally sends a slip to the tendons on either side of it, and in some cases entirely furnishes the tendon of the little finger. Thus the ring finger is incapable of independent extension.

The tendon of the little finger ordinarily sends a slip to the next tendon, and unites at the metacarpal joint with the radial border of the extensor proprius minimi digiti.

Action.—It is not only a general extensor of the fingers, but it can extend some of the phalanges independently of the rest: *e. g.* it can extend the first phalanges while the second and third are flexed; or it can extend the second and third phalanges during flexion of the first.

135. The *extensor digiti minimi or auricularis* is a long slender muscle situated between the extensor digitorum communis and the extensor carpi ulnaris. It arises from the common tendon from the external condyle, from the septa between it and the contiguous muscles, and from its own fascial covering. Its slender tendon of insertion continues to receive fleshy fibres nearly down to the annular ligament, beneath which it passes, immediately behind the joint between the radius and ulna, in a special sheath lined by synovial membrane.

At the first joint of the little finger, the tendon is joined by that of the common extensor, and both expand upon the dorsal surface of the first and second phalanges, terminating in the same manner as the extensor tendons of the other fingers.

136. The *extensor carpi ulnaris* is situated along the ulnar border of the back of the fore-arm. It arises from the common tendon from the external condyle, from the middle third of the posterior surface of the ulna, from the septum between it and the extensor minimi digiti, and from the aponeurosis of the fore-arm. The fibres descend longitudinally down the posterior border of the ulna, and terminate upon a strong broad tendon, which commences

high up in the substance of the muscle, and receives fleshy fibres on its deep surface nearly as low as the end of the ulna. The tendon then traverses a distinct groove on the back of the ulna, close to the styloid process, and is inserted into the inner and posterior part of the carpal end of the metacarpal bone of the little finger. Below the styloid process of the ulna, the tendon passes beneath the posterior annular ligament, over the back of the wrist, and is here contained in a very strong fibrous canal, which is attached to the back of the cuneiform, pisiform, and unciform bones, and is lined by a continuation from the synovial membrane in the groove of the ulna. The *action* of this muscle is to extend the hand, and incline it towards the ulnar side.

In pronation of the fore-arm, the lower end of the ulna projects between the tendons of the extensor carpi ulnaris and the extensor minimi digiti. A subcutaneous *bursa* is sometimes found above the bone in this situation; another is more deeply seated between the bone and the fascia, and in some instances communicates with the joint beneath it.

137. The *anconeus* is a small triangular muscle situated at the outer and back part of the elbow. It is covered by a strong layer of fascia, derived from the tendon of the triceps, and appears like a continuation of that muscle. It arises from the posterior part of the external condyle of the humerus, by a tendon which descends for some distance along the radial side of the muscle. The upper fibres, continuous with those of the triceps, pass transversely inwards, to be attached to the olecranon; the lower, increasing successively in length and obliquity, are inserted into the triangular surface, on the upper fourth of the outer part of the ulna. Part of the under surface of the muscle is in contact with the capsule of the elbow-joint. A *bursa* is sometimes found between its tendon and the head of the radius. Its *action* is to assist in extending the fore-arm.

138. *Deeper seated muscles on the back of the fore-arm.—* Detach from the external condyle the extensor carpi radialis brevis, the extensor digitorum communis, the extensor minimi digiti, and the extensor carpi ulnaris. Observe the small *bursa* which is situated between the common tendon of these muscles and that of

the supinator radii brevis beneath them. In reflecting the superficial muscles, preserve the vessels and nerves which enter their under surface. The deeper seated muscles now exposed are—

The supinator radii brevis,
extensor ossis metacarpi pollicis,
extensor primi internodii pollicis,
extensor secundi internodii pollicis,
extensor proprius indicis or indicator.

139. The *supinator radii brevis* muscle is situated over the upper third of the radius. It arises by tendinous fibres from the external lateral ligament of the elbow-joint, from the annular ligament surrounding the head of the radius, from an oblique ridge situated on the upper fourth of the outer surface of the ulna, below the insertion of the anconeus, and by fleshy fibres from a triangular excavation below the lesser sigmoid notch of the ulna. The muscular fibres turn over the neck and upper part of the shaft of the radius, and are inserted fleshy into the upper third of the outer surface of this bone, as far forwards as the ridge leading from the tubercle obliquely downwards and outwards to the insertion of the pronator teres. Some of the upper fibres embracing the neck of the radius are inserted above the tubercle.

The muscle is perforated obliquely by the deep branch of the musculo-spiral nerve (see § 39), and its upper part is in contact with the capsule of the elbow-joint. *Action.*—It is the most powerful supinator of the fore-arm, some of its fibres acting at nearly a right angle to the axis of the radius.

140. The *extensor ossis metacarpi pollicis* is the strongest of the extensor muscles of the thumb. It arises by a pointed extremity from the posterior surface of the ulna below the supinator brevis, with which it is generally more or less united; also by short aponeurotic fibres from a ridge on the middle third of the bone, and from the posterior surface of the radius, a little above its middle, as well as from the interosseous ligament. The muscle descends obliquely over the radius, crosses the radial extensors of the wrist about three inches above the carpus, and terminates in a tendon, which passes along a groove, lined by synovial membrane, on the

outer part of the lower end of the radius, and is inserted into the radial side of the base of the metacarpal bone of the thumb and the *os trapezium*. It also sends off a fascia, which covers the *abductor pollicis*. Between the tendon and the *os trapezium* there is often a small *bursa*, which in some instances communicates with the joint beneath.

141. The *extensor primi internodii pollicis* lies on the ulnar side of the preceding muscle, and takes the same direction. It arises from the posterior surface of the radius, below the extensor ossi metacarpi pollicis, from the interosseous ligament, and from the ulna. The thin muscle turns over the radial extensors of the wrist, and terminates upon a tendon which passes beneath the annular ligament, through the groove on the outer part of the radius, and is inserted into the radial side of the first phalanx of the thumb.

142. The *extensor secundi internodii pollicis* arises from the middle third of the posterior surface of the ulna, and from the interosseous ligament. The tendon upon which the muscle terminates receives fleshy fibres as low as the wrist, passes beneath the annular ligament in a distinct groove on the back of the radius, proceeds over the metacarpal bone and the first phalanx of the thumb, and is inserted into the base of the last phalanx.

The tendons of the three extensors of the thumb may be easily distinguished in one's own hand. The extensor ossis metacarpi, and *primi internodii pollicis*, cross obliquely over the radial artery, in the situation where it lies on the external lateral ligament of the carpus; the *extensor secundi internodii pollicis* crosses the artery just before it sinks into the palm, between the first and second metacarpal bones, and is a good guide to the vessel. The *action* of the three extensors of the thumb is implied by their names.

143. The *extensor indicis*, or *indicator* muscle, arises from the posterior surface of the ulna, and from the inter-osseous ligament. The tendon upon which the muscle terminates receives fleshy fibres as low as the wrist, passes beneath the posterior annular ligament, in the same groove on the back of the radius, with the tendons of the *extensor digitorum communis*. It

then proceeds over the back of the hand to the first phalanx of the index finger, where it is united to the ulnar border of the common extensor tendon. By the *action* of this muscle, the index finger can be extended independently of the others.

144. Relative position of the tendons over the back of the radius and ulna. Proceeding from the ulnar towards the radial side of the wrist, the tendons are situated in the following order, beneath the posterior annular ligament:—

The tendon of the—

Extensor carpi ulnaris, in a groove on the lower end of the ulna ;
Extensor minimi digiti, over the articulation between the radius
and ulna ;

Extensor digitorum communis, with the indicator, in the first
broad groove on the radius ;

Extensor secundi internodii pollicis, in a narrow groove on the radius
on the ulnar side of the middle tubercle.

Extensor carpi radialis brevior, } in the second broad groove on the
Extensor radialis carpi longior, } radius.

Extensor primi internodii pollicis, } in a groove on the outer side
Extensor ossis metacarpi pollicis, } of the radius.

145. Synovial sheaths of the extensor tendons.—The tendon of the extensor carpi ulnaris is contained in a separate tendinous sheath in its passage along the groove of the ulna and the back of the wrist. Make a longitudinal opening in the sheath, to see the synovial lining, and the fold which is reflected over the tendon. This synovial sheath is nearly two inches long, beginning about half an inch above the styloid process of the ulna, and terminating at the insertion of the tendon.

a. The tendon of the extensor minimi digiti has a separate tendinous sheath, formed entirely by the posterior annular ligament, and is situated immediately behind the articulation, between the radius and ulna. Its synovial sheath is from two to three inches long, and extends for some distance along the back of the hand.

b. The tendons of the extensor digitorum communis with the indicator are contained in the same groove on the back of the radius. The groove is lined by a synovial membrane, which is

reflected over each of the tendons, and accompanies them for a short distance on the back of the hand. The extent of the synovial sheath is about two inches.

c. The tendon of the extensor secundi internodii pollicis is contained in a narrow well-marked groove on the back of the radius. Its synovial sheath varies from two to three inches in length, and extends, in some instances, from the radius down to the first phalanx of the thumb. In the situation where this tendon crosses the extensor tendons of the carpus, a narrow communication is frequently formed between their respective synovial sheaths.

d. The tendons of the extensor carpi radialis brevior and longior are contained in the same groove on the back of the radius. Generally, there is a distinct synovial sheath for each tendon: that of the extensor brevior is about two inches in length, extending from the groove nearly to the insertion of the tendon; that of the extensor longior is commonly not more than one inch in extent.

e. The tendons of the extensor primi internodii pollicis and ossis metacarpi pollicis are contained in a groove on the outer part of the radius. Each has most commonly a separate synovial sheath, varying from two to two and a half inches in extent.

In some rare instances it is observed that one or more of the synovial sheaths of the extensor tendons communicate with the cavity of the wrist-joint.

146. The *posterior interosseous artery* is derived from the ulnar by a common trunk with the anterior interosseous (see § 67), and supplies the muscles on the back of the fore-arm. It passes between the radius and ulna above the interosseous membrane, and appears between the supinator radii brevis and the extensor ossis metacarpi pollicis. After supplying branches to all the muscles in this situation, the artery descends, much diminished in size, between the superficial and deep layer of muscles to the wrist, where it inosculates with the carpal branches of the anterior interosseous and those of the radial and ulnar arteries.

a. But the largest branch of this artery is the *recurrent*. It ascends beneath the anconeus muscle to the space between the external condyle and the olecranon, where it inosculates with the branch of the superior profunda, which descends in the substance

of the triceps muscle. It furnishes several branches to the muscles, and others which penetrate the capsule of the joint, and ramify upon the synovial membrane.

In the lower part of the back of the fore-arm, a branch of the anterior interosseous artery is seen passing through the interosseous membrane to reach the back of the wrist (see § 67).

147. The nerve which supplies the muscles on the back of the fore-arm is the *posterior muscular* (posterior interosseous of authors), a branch of the musculo-spiral (see § 39). It passes obliquely through the supinator radii brevis, and descends between the superficial and deep layer of muscles on the back of the fore-arm, sending to each a filament, generally in company with a branch of the posterior interosseous artery. It sends a branch to the extensor carpi radialis brevior, and supplies the supinator brevis in passing through its substance. The supinator radii longus and the extensor carpi radialis longior are supplied by distinct branches from the musculo-spiral (see § 39, *d*).

The continuation of the posterior muscular nerve sends a branch to the extensor secundi internodii pollicis and to the indicator, and then descends beneath the tendons of the extensor digitorum communis to the back of the wrist. In this situation the nerve forms a kind of gangliform enlargement, from which filaments are sent to the carpal and metacarpal joints.

On reviewing the distribution of the musculo-spiral nerve, we find that its branches supply the extensor and supinator muscles of the fore-arm, and the extensors of the hand, thumb, and fingers. Its cutaneous branches supply the lower part of the outer side of the upper-arm, the back of the fore-arm (see § 39, *c*), and the outer half of the back of the hand, as well as the back of the thumb and the two next fingers (see § 59).

148. *Course and branches of the radial artery on the back of the hand.*—Trace the continuation of the radial artery over the external lateral ligament of the carpus, beneath the extensor tendons of the thumb, to the upper part of the interval between the first and second metacarpal bones, where it sinks between the origin of the abductor indicis muscle, and, entering the palm, forms the deep palmar arch (see § 98). In this part of its course it is

crossed by filaments of the radial nerve; observe, also, that the tendon of the extensor secundi internodii pollicis passes over it immediately before it sinks into the palm. It supplies the following small branches to the back of the hand.

a. *Posterior carpal artery*.—This branch passes across the carpal bones beneath the extensor tendons. It inosculates with the termination of the anterior interosseous artery (see § 67), and sometimes with a corresponding branch from the ulnar artery. The carpal artery commonly sends off small branches, called the *dorsal interosseous*, which descend along the third and fourth interosseous spaces, beneath the extensor tendons, inosculating near the carpal ends of the metacarpal bones with the perforating branches from the deep palmar arch (see § 98, a).

b. The *dorsal interosseous artery* of the second space (sometimes called the metacarpal branch of the radial) is generally larger than the others. It descends over the second dorsal interosseous muscle to the cleft between the index and middle fingers, and terminates in small branches, some of which proceed along the back of the fingers, others inoscultate with the palmar digital arteries.

c. The *dorsal arteries of the thumb* are two small branches which arise from the radial opposite the head of the first metacarpal bone, and run along the back of the thumb, one on either side. They are often absent.

d. The *dorsal interosseous artery of the first space* (commonly called the dorsal artery of the index finger), a branch of variable size, passes over the first interosseous muscle to the radial side of the back of the index finger.

These dorsal interosseous arteries supply the extensor tendons and their sheaths, the interosseous muscles, and the skin on the back of the hand and the first phalanges of the fingers.

149. Remove the tendons from the back and from the palm of hand: observe the deep palmar fascia which covers the interosseous muscles. It is attached to the ridges of the metacarpal bones, forms a distinct sheath for each interosseous muscle, and is continuous inferiorly with the transverse metacarpal ligament. On the back of the hand the interosseous muscles are covered by a thin fascia, which is attached to the adjacent borders of the metacarpal bones.

a. The *transverse metacarpal ligament* consists of strong bands of ligamentous fibres, which pass transversely between the digital extremities of the metacarpal bones of the fingers. These bands are intimately united to the fibro-cartilaginous ligament of the metacarpal joints, and are of sufficient length to admit of a certain degree of movement between the ends of the metacarpal bones.

Remove the fascia which covers the interosseous muscles, and separate the metacarpal bones by dividing the transverse metacarpal ligament. A *bursa* is frequently developed in the cellular tissue, between their digital extremities.

150. *Interosseous muscles*.—These muscles, so named from their position, extend from the sides of the metacarpal bones to the first phalanges and the extensor tendons of the fingers. In each interosseous space there are two, one of which is an abductor, the other an adductor of a finger. According to this arrangement there ought to be eight: but since the adductor pollicis (first palmar interosseous) is usually described as a separate muscle, there remain only seven, four of which, situated on the back of the hand, are called dorsal; the remainder, seen only in the palm, are called palmar.

Each *dorsal* interosseous muscle arises from the opposite sides of two metacarpal bones, but more extensively from the metacarpal bone of the finger which the muscle moves. From this double origin the fibres converge to a tendon, which commences in the middle of the muscle, passes between the metacarpal joints of the fingers, and is inserted into the side of the first phalanx: it is also connected by a broad expansion with the extensor tendon on the back of the finger. The two portions of the double origin are separated by the perforating branch of the deep palmar arch (see § 98, a).

The *first* dorsal interosseous muscle (abductor indicis) is larger than the others, and occupies the interval between the thumb and fore-finger. It arises from the upper half of the ulnar side of the first metacarpal bone, and from the entire length of the radial side of the second: between the two origins, the radial artery passes into the palm. Its fibres converge on either side to a tendon, which is inserted into the *radial* side of the first phalanx of the index finger and its extensor tendon.

The *second* dorsal interosseous muscle occupies the second metacarpal space. It is inserted into the radial side of the first phalanx of the middle finger and its extensor tendon.

The *third* and *fourth*, occupying the corresponding metacarpal spaces, are inserted, the one into the ulnar side of the middle, the other into the ulnar side of the ring finger.

Action.—If an imaginary line be drawn longitudinally through the middle finger, we shall find that all the dorsal interosseous muscles are abductors from that line; consequently, they separate the fingers from each other.

The *palmar interosseous muscles*.—It requires a careful examination to distinguish this set of muscles, because the dorsal muscles protrude with them into the palm. They are smaller than the dorsal, and each arises from the lateral surface of only one metacarpal bone, that, namely, connected with the finger into which the muscle is inserted. They terminate in small tendons, which pass between the metacarpal joints of the fingers, and are inserted, like the dorsal muscles, into the sides of the first phalanges and the extensor tendons on the back of the fingers.

The *first* palmar interosseous muscle arises from the ulnar side of the second metacarpal bone, and is inserted into the ulnar side of the index finger. The *second* and *third* arise, the one from the radial side of the fourth, the other from the radial side of the fifth metacarpal bone, and are inserted into the same sides of the ring and little fingers.

Action.—The palmar interosseous muscles are all adductors to an imaginary line drawn through the middle finger. They are, therefore, the opponents of the dorsal interosseous muscles, and move the fingers towards each other. Both palmar and dorsal interosseous muscles act with greater advantage when the fingers are extended.

DISSECTION OF THE LIGAMENTS.

151. JOINT BETWEEN THE CLAVICLE AND THE STERNUM.—The inner end of the clavicle articulates with a shallow excavation on the upper and outer part of the sternum. From the form of

the articular surfaces of the bones, it is plain that the security of the joint must depend upon the strength of its ligaments. There are two synovial membranes, and an intervening fibro-cartilage.

The *anterior sterno-clavicular ligament* consists of a broad band of ligamentous fibres, which pass obliquely downwards and inwards over the front of the joint, from the anterior border of the end of the clavicle to the anterior surface of the sternum.

A similar band, called the *posterior sterno-clavicular ligament*, extends over the back of the joint, from the posterior border of the clavicle to the posterior surface of the sternum.

The clavicles are connected by what is called the *inter-clavicular ligament*. It extends transversely above the notch of the sternum, and has a broad attachment to the upper border of each clavicle. Between the clavicles it is more or less attached to the sternum, so that it forms a curve with the concavity upwards.

The three ligaments just described are so closely connected, that, collectively, they form a complete fibrous capsule of great strength for the joint.

A ligament, called the *costo-clavicular* or *rhomoid*, connects the clavicle to the cartilage of the first rib. It ascends from the cartilage of the rib to a rough surface beneath the sternal end of the clavicle. Its use is to limit the elevation of the clavicle. There is such constant movement between the clavicle and the cartilage of the first rib, that a well-marked *bursa* is commonly found between them.

Inter-articular fibro-cartilage.—In order to see this, we must cut through the rhomoid, the anterior and posterior ligaments of the joint, and then raise the clavicle. It is nearly circular in form, and thicker at the circumference than the centre, in which there is sometimes a perforation. Inferiorly, it is attached to the cartilage of the first rib, close to the sternum; superiorly, to the upper part of the clavicle and the inter-clavicular ligament. Its circumference is inseparably connected with the fibrous capsule of the joint.

The joint is provided with two synovial membranes: one is placed between the articular surface of the sternum and the inner surface of the fibro-cartilage; the other, between the articular surface of the clavicle and the outer surface of the fibro-cartilage.

The probable purpose served by the fibro-cartilage is to adapt the articular surface of the sternum more accurately to the different movements of the clavicle. It also acts as a ligament, preventing the clavicle from being driven inwards towards the mesial line. The two synovial membranes greatly facilitate the motions of the joint.

Observe the relative form of the cartilaginous surfaces of the bones: that of the sternum is slightly concave in the transverse, and convex in the antero-posterior direction; that of the clavicle is the reverse.

The form of the articular surfaces and the ligaments of a joint being known, it is easy to understand the movements of which it is capable. The clavicle can move upon the sternum in a direction either vertical or horizontal: thus it admits of circumduction. These movements, though very limited at the sternum, become very considerable at the apex of the shoulder.

152. CONNEXION OF THE CLAVICLE WITH THE SCAPULA.—
The outer end of the clavicle articulates with the acromion, and is connected by strong ligaments to the coracoid process of the scapula.

Joint between the acromion and the clavicle.—The clavicle and the acromion articulate with each other by means of two flat oval cartilaginous surfaces, of which the planes are nearly vertical, and the greater diameters in the antero-posterior direction.

The *superior ligament*, a broad band of ligamentous fibres, strengthened by the aponeurosis of the trapezius, extends from the upper surface of the acromion to the upper surface of the clavicle.

The *inferior ligament*, of lesser strength, extends along the under surface of the joint from bone to bone.

An *inter-articular fibro-cartilage* is often found in this joint: it is incomplete, and seldom extends lower than the upper half. There is only one synovial membrane.

Coraco-clavicular ligament.—The clavicle is connected to the coracoid process of the scapula by two strong ligaments—the *conoid* and *trapezoid*, which, being continuous with each other, might fairly be considered as one. The *trapezoid* ligament is the more anterior. It arises from the back part of the upper surface of the

coracoid process, and ascends obliquely outwards to the lower surface of the clavicle near its outer end. The *conoid* ligament is fixed at its apex to the inner side of the root of the coracoid process, ascends vertically, and is attached by its base to the under surface of the clavicle, near the posterior border. There is commonly a *bursa* between the two ligaments when the clavicle and the coracoid process are in contact.

153. *Ligaments proper to the scapula*.—There are only two: the *coracoid* ligament, which is attached to the opposite margins of the supra-scapular notch, and the *coraco-acromial* or *triangular* ligament, which is attached by its apex to the acromion, and by its base to the outer border of the coracoid process. It is separated from the upper part of the capsule of the shoulder-joint by a large *bursa*, and an aponeurosis descends from its front border over the head of the humerus.

In a few rare instances the acromion is connected to the spine of the scapula by an intervening fibro-cartilage; or there may be a distinct articulating surface, provided with a capsular ligament and a synovial membrane.

154. SHOULDER-JOINT.—The articular surface of the head of the humerus, forming rather more than one-third of a sphere, moves upon the shallow glenoid cavity of the scapula, which is of an oval form, with the broader end downwards, and the long diameter nearly vertical. It is obvious that the security of the joint does not depend upon any mechanical contrivance of the bones, but rather upon the great strength and number of the tendons which surround it.

To admit the free motion of the head of the humerus upon the glenoid cavity, it is requisite that the *capsular ligament* of the joint be very loose and capacious. Accordingly we find that the head of the bone, when detached from its muscular connections, may be separated from the glenoid cavity to the extent of an inch, or even more, without laceration of the capsule. This explains the elongation of the arm observed in some cases in which effusion has taken place into the cavity of the joint; also in some cases of paralysis of the deltoid muscle.

The *capsular ligament* is attached, on the one hand, round the

circumference of the glenoid cavity ; and, on the other, round the surgical neck of the humerus. It is strengthened on its upper and posterior surface by the tendons of the supra-spinatus, infra-spinatus, and teres minor muscles ; its internal surface is inseparably connected with the broad tendon of the subscapularis, and inferiorly it is in contact with the long head of the triceps. Thus the circumference of the capsule is surrounded by tendons on every side, excepting a small space towards the axilla. If the humerus be raised, it will be found that the head of the bone rests upon this unprotected portion of the capsule ; that is, between the tendons of the subscapularis and the long head of the triceps ; and through this part of the capsule the head of the bone usually protrudes in dislocations into the axilla.

At the upper and inner side of the joint, a small opening, sometimes called the *foramen ovale*, is observable in the capsular ligament, through which the tendon of the subscapularis passes, and comes in contact with the synovial membrane.

The upper surface of the capsule is, moreover, strengthened by a strong band of ligamentous fibres, commonly called the *coraco-humeral* or *accessory ligament*. It is attached to the outer border of the root of the coracoid process, expands over the upper and outer surface of the capsule, with which it is inseparably united, and is fixed with it into the greater tuberosity of the humerus.

Open the capsule by a transverse incision through its axillary surface. By raising the head of the humerus, the tendon of the long head of the biceps will be seen at the upper part of the joint. It enters the joint through the groove between the two tuberosities, becomes slightly flattened, and passes over the head of the bone to be attached to the upper border of the glenoid cavity. It is loose and moveable within the joint ; and it is said to act like a strap, supporting the head of the bone, and keeping it in accurate apposition with the glenoid cavity. In some cases, the tendon, having been ruptured by violence, has contracted an adhesion to the bicipital groove.

The tendon of the biceps does not perforate the synovial membrane of the joint. It is enclosed in a kind of tubular sheath,

which is reflected over it at its attachment to the glenoid cavity, and accompanies it for two inches down the groove of the humerus. During the earlier part of foetal life it is connected to the capsule by a fold of synovial membrane, which subsequently disappears.

The margin of the glenoid cavity of the scapula is surrounded by a fibro-cartilaginous band of considerable thickness, called the *glenoid ligament*. This not only enlarges the cavity, but renders it a little deeper. Superiorly, it is continuous on either side with the tendon of the biceps; inferiorly, with the tendon of the triceps: in the rest of its circumference it is attached to the edges of the cavity.

Observe that the cartilage covering the head of the humerus is thicker at the centre than at the circumference. The reverse is the case in the glenoid cavity.

The *synovial membrane* lining the under surface of the capsule is reflected around the tendon of the biceps, and passes with it, in the form of a cul-de-sac, down the bicipital groove. On the inner side of the joint it always communicates with the bursa beneath the tendon of the subscapularis.

The shoulder-joint has a more extensive range of motion than any other joint in the body: it is, in fact, a kind of universal joint. It is capable of motion forwards and backwards; of adduction, abduction, circumduction, and rotation.

155. ELBOW-JOINT.—Detach the brachialis anticus from the anterior, and the triceps from the posterior surface of the capsule of the joint. Remove the tendons attached to the condyles without injuring the lateral ligaments.

The elbow-joint is a perfect hinge. The larger sigmoid cavity of the ulna is accurately adapted to the trochlea upon the lower end of the humerus, admitting of simple flexion and extension; while the shallow excavation upon the head of the radius admits not only of flexion and extension, but also of rotation upon the rounded articular eminence (*capitellum*) of the humerus. The joint is secured by an anterior, a posterior, and two strong lateral ligaments. No ligament is attached to the head of the radius,

otherwise its rotatory movement would be impeded. It is simply surrounded by a ligamentous collar, called the annular ligament, within which it freely rolls.

Internal lateral ligament.—This is somewhat fan-shaped, and is made more conspicuous by bending the joint. Its apex is attached to the lower part of the internal condyle of the humerus : from this point the fibres radiate, and are inserted into the inner border of the greater sigmoid cavity of the ulna.

A transverse band of ligamentous fibres extends from the olecranon to the coronoid process, across a notch observable on the inner side of the sigmoid cavity : through this notch vessels pass into the joint.

External lateral ligament.—This is attached to the external condyle of the humerus ; the fibres spread out as they descend, and are interwoven with the annular ligament, surrounding the head of the radius. Some of them are implanted into the anterior and the posterior borders of the lesser sigmoid cavity of the ulna.

The *anterior ligament* consists of a thin fibrous membrane, situated over the front of the joint. It is attached, superiorly, to the front of the lower end of the humerus ; inferiorly to the annular ligament of the radius, and the border of the coronoid process of the ulna. Some of its fibres take an oblique, others a vertical direction.

The *posterior ligament* consists of a few thin ligamentous fibres, which extend across the fossa at the lower end of the back of the humerus.

These ligaments, collectively, form a continuous capsule round the elbow-joint.

The orbicular or annular ligament of the radius is attached to the anterior and the posterior border of the lesser sigmoid cavity of the ulna. With this cavity, it forms a complete collar, which encircles the head and upper part of the neck of the radius, without impeding its capability of rotation. The lower part of the collar is narrower than the upper, in order to fit the neck of the radius, and maintain it more accurately in its position. Its outer surface receives the attachment of the external lateral ligament.

Divide the ligament longitudinally, to see its attachment to the borders of the lesser sigmoid cavity.

Synovial membrane of the elbow-joint.—Open the joint by a transverse incision through the anterior ligament, and observe the relative adaptation of the cartilaginous surfaces of the bones. The synovial membrane lines the interior of the capsule, and forms a cul-de-sac between the head of the radius and its orbicular ligament. It is widest and most loose under the tendon of the triceps. Where the membrane is reflected from the bones upon the ligaments, there is more or less adipose tissue, particularly in the fossæ on the front and back part of the lower end of the humerus.

Observe that the head of the radius is in contact with the humerus only when the elbow-joint is flexed.

156. The *interosseous ligament* or *membrane* is an aponeurotic septum, which is stretched across the interval between the bones of the fore-arm, and of which the chief purpose is to afford an increase of surface for the attachment of muscles. The septum is deficient between the upper ends of the bones, in order to permit free rotation of the radius : it is also sometimes deficient between the lower ends. The fibres of which it is composed extend obliquely downwards from the ridge of the radius to the opposite ridge of the ulna. It is broader in the middle than at either end, and is perforated by several small vessels, but more especially by the dorsal branch of the anterior interosseous artery (see § 67).

The name of *round* or *oblique ligament* is given to a thin band of ligamentous fibres, which extends obliquely between the bones of the forearm in a direction contrary to those of the interosseous membrane. It is attached, superiorly, to the front surface of the ulna, near the outer side of the coronoid process ; inferiorly, to the radius immediately below the tubercle. A *bursa* commonly intervenes between it and the insertion of the tendon of the biceps. This ligament is rendered tense by supination of the radius.

157. RADIO-CARPAL OR WRIST-JOINT.—This joint is formed by the lower end of the radius, which articulates with the scaphoid

and semilunar bones of the carpus : the lower end of the ulna is excluded from the joint by a triangular fibro-cartilage, which articulates with a small portion of the cuneiform bone. The joint is secured by an anterior, a posterior, and two lateral ligaments, forming, together, an uninterrupted capsule around it.

The *external lateral ligament* extends from the styloid process of the radius, to the outer side of the scaphoid bone. Some of its fibres are prolonged to the trapezium and the anterior annular ligament.

The *internal lateral ligament* proceeds from the extremity of the styloid process of the ulna, to the inner side of the cuneiform bone. Some of its fibres are attached to the pisiform bone.

The *anterior ligament* consists of two or more broad bands of ligamentous fibres, which arise from the front of the lower end of the radius, pass obliquely inwards, and are inserted into the front surfaces of the first row of carpal bones.

The *posterior ligament*, weaker than the preceding, arises from the posterior surface of the lower end of the radius, descends obliquely inwards, and is inserted into the posterior surfaces of the first row of the carpal bones.

Open the joint by a transverse incision across its posterior part. Observe that the lower surface of the radius, crusted with cartilage, forms, together with the fibro-cartilage at the end of the ulna, an arched excavation, with the broad diameter transverse, which receives the convex cartilaginous surfaces of the three first bones of the carpus. The cartilage of the radius presents a slight prominence from before backwards, dividing it into two surfaces, one of which corresponds to the scaphoid, the other to the semilunar bone. The fibro-cartilage at the lower end of the ulna corresponds to a small articular surface on the cuneiform bone.

The *synovial membrane* lines the triangular fibro-cartilage at the end of the ulna, is reflected over the several ligaments of the joint, and thence upon the first row of the carpal bones.

158. JOINT BETWEEN THE LOWER ENDS OF THE RADIUS AND ULNA.—The inner surface of the lower end of the radius presents a slight concavity, which rotates upon the convex circumference of

the lower end of the ulna : this mechanism is essential to the pronation and supination of the hand. These corresponding surfaces are crusted with a thin layer of cartilage, and are provided with a loose synovial membrane. The joint is strengthened in front and behind by a thin, loose, fibrous capsule, which extends from the anterior and posterior borders of the sigmoid cavity of the radius, to the anterior and posterior surfaces of the styloid process of the ulna. But the principal uniting medium between the bones is a strong fibro-cartilage.

Fibro-cartilage between the radius and ulna.—Saw through the bones of the fore-arm, and separate them by cutting through the interosseous membrane, and opening the synovial membrane of the joint between their lower ends. A good view will thus be obtained of the fibro-cartilage which connects them. It is triangular in form, and is placed transversely below the inferior extremity of the ulna, filling up the interval caused by the greater length of the radius. Its base is attached to the inner edge of the lower end of the radius, and its apex to the root of the styloid process of the ulna. It is thin at the base and the centre, thicker at the apex and the sides. Its upper surface is in contact with the ulna, and covered by the synovial membrane of the radio-ulnar joint ; its lower surface forming a part of the wrist-joint, corresponds to the cuneiform bone. Its borders are connected with the anterior and posterior ligaments of the wrist. In some instances there is an aperture in the centre.

The *synovial membrane* of this joint is distinct from that of the wrist, except in the case of a perforation through the fibro-cartilage. One portion extends perpendicularly between the contiguous surfaces of the radius and ulna, the other horizontally between the head of the ulna and the upper surface of the fibro-cartilage. On account of its great looseness, necessary for the free rotation of the radius, it is often called the *membrana sacciformis*.

159. CONNEXION OF THE CARPAL BONES WITH EACH OTHER.—The bones of the carpus are arranged in two rows, an upper and a lower, adapted to each other, so as to form between them a joint, connected by anterior, posterior, internal, and external lateral ligaments.

The bones, constituting each row, are united by ligaments placed on their palmar and dorsal surfaces, and by others, placed between the bones, and hence called interosseous. Their contiguous surfaces (those of the pisiform and cuneiform excepted), are covered by the reflections of one synovial membrane.

The *upper row* is united by *transverse* ligaments proceeding from the scaphoid to the semilunar bone, and from the semilunar to the cuneiform, both on their dorsal and palmar surfaces: also, by *interosseous* ligaments, proceeding from the semilunar to the bones on either side of it.

The *pisiform bone* is articulated to the palmar surface of the cuneiform bone, to which it is united by a fibrous capsule. Inferiorly, it is attached by two strong ligaments, the one to the unciform bone, the other to the carpal end of the fifth metacarpal bone. This little articulation has, in the great majority of cases, a distinct synovial membrane: but, in some rare instances, it communicates with the radio-carpal joint.

The *lower row* of carpal bones is connected precisely in the same way as the upper. The dorsal and palmar ligaments pass transversely from one to the other. There are only two interosseous ligaments, one on either side of the *os magnum*; they are much thicker and stronger than those of the upper row, and unite the bones more firmly together.

160. INTERCARPAL JOINT.—The upper row of carpal bones is arranged in the form of an arch, so as to receive the corresponding convex surfaces of the *os magnum* and *unciforme*. Externally to the *os magnum*, the trapezium and trapezoid bones present a slightly concave surface, which articulates with the scaphoid. In this way a joint capable of flexion and extension is formed between the upper and lower row. It is secured by anterior, posterior, and two lateral ligaments, which are sufficiently loose to admit of the motion required. The anterior ligament consists of strong ligamentous fibres, which pass obliquely from the bones of the upper to those of the lower row. The posterior ligament consists of oblique and transverse fibres, which connect the dorsal surfaces of the bones of the upper with the lower row.

The lateral ligaments connect, externally, the scaphoid and trapezium; internally, the cuneiform and unciform bones.

Divide the ligaments, in order to see the manner in which the carpal bones articulate with each other. Their surfaces are crusted with cartilage, and provided with a common *synovial membrane*. This membrane extends, superiorly, between the three bones of the upper row, so as to form two *culs-de-sac*; inferiorly, it is prolonged into the joint between the carpal and the second and third metacarpal bones. In some cases it is continuous with the synovial membrane of the radio-carpal joint.

The joint between the upper and lower row of carpal bones admits of flexion and extension only; but flexion is less limited than extension. The reverse is the case with regard to the radio-carpal joint.

161. JOINT BETWEEN THE TRAPEZIUM AND THE METACARPAL BONE OF THE THUMB.—The trapezium presents a cartilaginous surface, convex in the transverse, and concave in the antero-posterior direction, (*i. e.* somewhat saddle-shaped,) which articulates with a cartilaginous surface on the metacarpal bone of the thumb, concave and convex in just the opposite directions. This peculiar adaptation of the two surfaces permits the several movements of the thumb, viz., flexion, extension, abduction, and adduction; consequently circumduction. Thus we are enabled to oppose the thumb to all the fingers. The joint is surrounded by a fibrous capsule sufficiently loose to admit free motion, and stronger on the dorsal than on the palmar aspect. The security of the joint is also increased by the muscles which surround it, and by the insertion of the tendon of the extensor ossis metacarpi pollicis. It has a separate synovial membrane.

162. CONNEXION BETWEEN THE CARPUS AND THE METACARPAL BONES OF THE FINGERS.—The metacarpal bones of the fingers are connected to the second row of the carpal bones by ligaments upon their *palmar* and their *dorsal* surfaces.

The *dorsal* ligaments are the stronger. The metacarpal bone of the fore-finger has two: one from the trapezium, another from the trapezoid bone. That of the middle finger has also two, proceeding from the *os magnum*, and the *os trapezoides*. That of

the ring finger has also two, proceeding from the os magnum, and the unciform bone. That of the little finger has one only, from the unciform bone.

The *palmar* ligaments are arranged nearly upon the same plan. The metacarpal bone of the forefinger has one, from the trapezoid bone. That of the middle finger has three, proceeding from the trapezium, the os magnum, and the unciform bone. Those of the ring and little fingers have each one, from the unciform bone.

Besides the preceding ligaments, there is another of considerable strength, called the *interosseous*. It arises from the adjacent sides of the os magnum and the os unciforme, descends vertically, and is fixed into the ulnar side of the metacarpal bone of the middle finger. This ligament isolates the synovial membrane of the two inner metacarpal bones from the common synovial membrane of the carpus.

Separate the metacarpal bones from the carpus, by dividing the dorsal ligaments, and observe the relative form of their contiguous cartilaginous surfaces. The metacarpal bones of the fore and middle fingers are adapted to the carpus in such an angular manner as to be very slightly immovable. The metacarpal bone of the ring finger, having a plane articular surface with the unciform bone, admits of more motion. But a still greater degree of motion is permitted between the unciform bone and the metacarpal bone of the little finger; the articular surfaces of each being slightly concave and convex in opposite directions. The greater freedom of motion of the metacarpal bone of the little finger is obviously essential to the expansion and contraction of the palm.

The *carpal extremities of the metacarpal bones of the fingers* are connected with each other by transverse ligaments, both on their dorsal and their palmar surfaces. They are also connected by interosseous ligaments, which extend between the bones, immediately below their contiguous cartilaginous surfaces.

The *digital extremities* of these bones are connected by the transverse metacarpal ligament (see 149, *a*).

The bones of the carpus and metacarpus should be separated from each other, in order to examine more thoroughly the form of their articular surfaces and their interosseous ligaments.

There are six distinct synovial membranes, proper to the lower end of the radius, and the several bones of the carpus :—

- a. One between the lower end of the radius and the ulna.
- b. One between the radius and the first row of carpal bones.
- c. One between the trapezium and the metacarpal bone of the thumb.
- d. One between the cuneiform and pisiform bones.
- e. One between the first and second rows of carpal bones, (the intercarpal joint.)
- f. One between the unciform bone and the metacarpal bones of the little and ring fingers.

This extends to the metacarpal bones of the fore and middle fingers.

163. JOINTS BETWEEN THE METACARPAL BONES AND THE PHALANGES OF THE FINGERS.—The first phalanx of the finger presents a shallow oval cavity, crusted with cartilage, with the broad diameter in the transverse direction, to articulate with the rounded cartilaginous head of the metacarpal bone, of which the articular surface is elongated in the antero-posterior direction, and of greater extent on its palmar than its dorsal aspect. This formation of parts permits flexion of the finger to a greater degree than extension ; and also a slight lateral movement.

Each joint is provided with two strong *lateral*, and a *palmar* or *glenoid* ligament.

The *lateral* ligaments arise from the tubercles on either side of each metacarpal bone, and inclining slightly forward, are inserted into the sides of the base of the first phalanx of the finger.

The *palmar* or *glenoid* ligament. This name is applied to a thick, compact, fibro-cartilaginous structure, which extends over the palmar surface of the joint. Inferiorly, it is firmly attached to the base of the first phalanx of the finger ; superiorly, it is loosely adherent to the rough surface above the head of the metacarpal bone. On either side it is inseparably connected with the lateral ligaments, so that with them it forms a strong capsule over the front and sides of the joint. Its superficial surface is slightly grooved, to receive the flexor tendons ; its deep surface is adapted to cover the head of the metacarpal bone. Two sesamoid

bones are found in the glenoid ligament belonging to the joint between the metacarpal bone and the first phalanx of the thumb. These joints are secured on their dorsal aspect by the passage of the extensor tendon, and the expansion proceeding from it on either side. Their synovial membranes are loose, especially beneath the extensor tendons.

164. JOINTS BETWEEN THE PHALANGES OF THE FINGERS AND THE THUMB.—The corresponding articular surfaces of the phalanges of the finger and thumb are so shaped as to form a hinge-joint, and, therefore, incapable of lateral movement. The ligaments connecting them are similar in every respect to those between the metacarpal bones and the first phalanges. The glenoid ligament of the last joint of the thumb generally contains a sesamoid bone.

END OF PART I.



